THE

JOURNAL OF ECONOMIC BIOLOGY

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VOLUME III.

1908.

LONDON:

DULAU AND CO., 37, SOHO SQUARE, W.

1908.

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THE

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THE BIOLOGY OF POLYSTICTUS VERSICOLOR (Fries).

By

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With Plates I and II.

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1.—Introduction.

Polystictus versicolor (Fries) is one of the numerous fungi which cause the rotting of wood. Its small fruit bodies are to be found during most months of the year on dead logs lying in moist situations; but under the climatic conditions of England it is especially during the autumn months, and thence onward to late spring, that they appear in great abundance. The fungus is one of the most familiar objects to the field mycologist, but its life-history and ecology seem, hitherto, to have been neglected (Pl. I, fig. 1).

The tough, leathery, neutral-tinted and velvety-topped fruit bodies or sporophores are never more than 4 or 5 cms. across, and unless occurring in great masses form quite inconspicuous objects. These horizontally projecting bracket-like sporophores, semi-circular in form, are of the dimidiate type, being attached to their woody host

by a broad surface; and sometimes, when climatic conditions are favourable, owing to their densely imbricate manner of growth, their broad attaching bases meet and unite, and then whole sheets, even to a square foot or more in area, may be stripped away from the substratum.

The upper surface of the pileus is slightly depressed behind, and since it is covered with fine hairs looks and feels like velvet; a concentric zoning (Pl. I, fig. 9) of various neutral-toned green, yellow, grey, brown and buff bands is always more or less noticeable: the smooth, flat hymenial surface is white at first, but changes to a deep cream colour, and on drying often presents a bright sheeny appearance. When the fungus grows on the rounded top of a horizontal log, specimens of sporophores resembling an umbrella-shaped species with an almost sessile pileus are frequently found, since in such a position a lateral outgrowth is able to extend from every side of a short stem-like base: also on the sides of nearly vertical logs a form almost resupinate, with the hymenial tubes for the most part reduced to mere grooves, is not uncommon.

The fungus is a pure saprophyte, whose natural habitat is moist dead wood: it seems highly probable that it will grow on almost any kind of wood except that of conifers.

I have found it growing on *Quercus robur*, *Fraxinus excelsior*, *Pyrus aucuparia*, *Salix alba*, *Betula alba*, *Pyrus malus*, *Ligustrum vulgare* and *Crataegus oxyacantha*, and have been able to infect without difficulty small blocks of *Fraxinus excelsior*, *Ulmus campestris*, *Prunus avium*, *Alnus glutinosa*, *Acer pseudoplatanus*, *Aesculus hippocastanum* and *Betula alba*, and have successfully cultivated the fungus from spore to spore.

2.—Spores and their Germination.

If a fresh fruit body is placed on a glass slide or paper a plentiful supply of spores is obtained in the course of a few hours: they are best seen macroscopically on black paper, where the numerous little white heaps look like an imprint of the hymenial surface of the sporophore.

Microscopic examination shows each spore to be a colourless oval unicellular body, $5\text{-}6 \times 2\mu$, in the protoplasm of which can be distinguished two, or sometimes three, groups of granules (Pl. II, fig. 1).

The spores germinate very readily in ordinary tap water, or even distilled water. Within eighteen hours, at a temperature of 19° C., nearly all become swollen, and quite 50 % produce germ tubes, 1, 2, 3, or 4 times their own length, and within three days all will germinate.

The germ tube arises at any position of the spore; sometimes abruptly; but more often it seems merely a gradual tapering prolongation of the spore wall: two germ tubes are frequently put forth, and occasionally, before a germ tube is protruded, a division wall is formed across the swollen spore (Pl. II, figs. 2 and 3).

Germination is not influenced by the presence or absence of light.

2*a*. *Hanging-Drop Cultures.*—In order to observe the further development of the germ tube, and the formation of a mycelium, hanging-drop cultures were made, due precautions being taken to use well sterilized apparatus and culture media. Spores were collected upon sterilized paper on glass slides, and were introduced into the culture by means of a sterilized platinum wire. Since a mere touch of the platinum wire will convey hundreds of spores to a drop, when only a few spores were wanted a series of fractional drop dilutions was made on cover glasses, until at last a dilution was obtained from which cultures containing about 5 or 6 spores each could be made.

The culture media used were distilled water, tap water, 8 per cent. gelatine, 12 per cent. cane sugar, 6 per cent. cane sugar, sections of oak, sycamore, cherry, ash, 5 per cent. witté peptone, 5 per cent. alcohol, vaseline, filter paper, 4 per cent. glycerine, thin boiled starch paste and malt extract solidified with 10 per cent. gelatine.

The malt gelatine afforded a good culture medium. In it spores germinated within thirty-six hours, and within two days produced long narrow septate hyphae rich in protoplasm. The progress of the hyphae was rendered very conspicuous by the gradual liquifaction of the gelatine in their vicinity. After seven or eight days the protoplasm in the hyphae commenced to break up into lengths, separated from one another by empty spaces; and later these protoplasmic lengths again broke up into very short rod-like cells (Pl. II, fig. 4) which are no doubt analogous to the rod-like gonidia observed by Brefeld [1] in the young mycelial hyphae of many *Coprini*, and to the oidia which Falck [2] describes as forming a stage in the life-history of *Collybia tuberosa*, *Hypholoma fascicularis*, and other Hymenomycetes, and again which Buller [3] found to occur in *Polyporus squamosus*.

Several of these rod-like oidia were transferred to other hanging-drop cultures; they germinated immediately, and produced a mycelium, which about the seventh day broke up into oidia just as the mycelium from the spore did. This oidial formation continued for

[1] Brefeld, quoted from De Bary, Fungi, Mycet. and Bact. (Eng. Ed.), 1887, p. 332.

[2] Falck, Beitr. z. Biol. d. Pflanzen, 1902, Bd. viii. Die Cultur des Oidien und ihre Rüchführung in die höhere Fruchtform bei den Basidiomyceten.

[3] Buller, Journ. Econ. Biol., 1906, vol. i, p. 117.

two or three months, after which all the oidia grew out into long thin branching hyphae, among which clamp and H connections were frequent. By the end of another three months the hanging-drop appeared to be drying up, and the mycelial development looked very exhausted, and poor in protoplasm, and contained numerous large bright refractive drops—no doubt oil drops. At this stage the hyphae in many places became much wider and formed large rounded cells, some with a lining layer of protoplasm surrounding a bright refractive drop, others remained empty: this stage was followed immediately by a budding process: small bud-like branches were developed from these large cells, and after the formation of a division wall, cutting them off from the main cell, became free; or these bud-like branches remained attached and cells were budded off from them (Pl. II, fig. 5). These conidia-like cells also had a protoplasmic lining, and contained a large glistening drop. Here again there is a strong resemblance to the conidial and yeast-like forms of oidia which Falck[1] observed occurring in the exhausted cultures of *Collybia tuberosa*. These oval conidia increased in size and then budded again or a division wall was formed across the cell previous to the budding: sometimes the budding went on so quickly that a chain of cells was formed just as is found in actively budding yeast. To one culture containing numbers of these conidia a minute drop of malt wort gelatine was added, and within a few days a rich mycelial development was formed, and within nine days the protoplasm in the hyphae had begun to divide up into short lengths, just as in the first mycelium from the spore. A few of these conidia were transferred to malt gelatine drop-cultures: with some the budding only continued, others put forth germ tubes which became septate, increased in size, and then gave off buds (Pl. II, fig. 6): these buds were much larger than those of the exhausted culture, more often double-celled, were richly protoplasmic, and without a large central glistening drop, although small oil drops were to be seen. These oidia when budded off were colourless, but gradually assumed a pale olive green tint, and sometimes before germinating they surrounded themselves with another cell wall, which had an irregular outline (Pl. II, fig. 6*d*). A similar budding process was observed in a distilled water hanging-drop culture containing many spores, when it was moistened again after having dried up within forty-eight hours of being made, at the stage when many spores had swollen, and just a few had put forth very short germ tubes. Here again the conidial form seems to have arisen owing to starvation.

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[1] Falck, *l.c.*

Cultures in 4 per cent. glycerine and boiled starch paste behaved very similarly to one another. The spores swelled very much and produced very wide germ tubes which became septate: at intervals one or more cells in succession became much swollen, some contained protoplasm, others remained empty; sometimes the ends of short branches swelled out into large round cells (Pl. II, fig. 10). A similar arrangement of enlarged cells intercalated in the hyphae were seen in the mycelium inside a pitted duct of mountain ash wood in a very advanced stage of decay, and again it occurred very frequently along the hyphae on an ash culture, which for no apparent reason was not thriving as other ash cultures usually did, and also on a poor culture of horse chestnut.

Both 8 per cent. gelatine and 5 per cent. witté peptone were quite as good media as malt extract solidified with gelatine: in cane sugar (12 per cent. and 6 per cent.) the spores died, apparently owing to plasmolysis: no germination took place in 5 per cent. alcohol or in vaseline: in 5 per cent. glucose the spores germinated within twenty-four hours.

The cultures in which were placed minute chips of oak, sycamore, cherry, ash and alder did not prove very successful: the spores germinated and produced a poor mycelium, whose hyphae could be distinguished penetrating walls or going through pits. These cultures stopped growth after a few weeks; nor was insufficient aeration the cause, for occasionally and momentarily raising the cover glass brought about no further growth.

In the cherry chip culture the mycelium was chiefly produced in the pitted vessels of the chip: a brown resinous substance, probably some degradation product, made its appearance also.

No chemotropic stimulus could be attributed to the wood, for germ tubes continued to grow in whatever direction they started growth, no matter the position of the chip.

2b. Flask and Tube Cultures.—Cultures in flasks and test-tubes, filled to one-fourth their depth with 8 per cent. gelatine, were observed for six months. The fungus behaved just as in the hanging-drop cultures: the gelatine was gradually liquified, and presented a white cloudy appearance; beginning first at the surface, where the infection was made, and progressing downwards. After two months all the mycelium had broken up into oidia; four months later the oidial form had passed over to the mycelial form, although a few oidia were still to be seen. Each culture after being examined was attacked by *Pencillium*, and so had to be discarded.

Flask cultures using 4 per cent. glycerine were under observation

for more than twelve months, but only an extremely spare growth of mycelium appeared. This mycelium was similar to that seen in the hanging-drop cultures, that is, many of the hyphae were abnormally wide and very vacuolate, and large rounded cells containing a bright glistening drop were frequent: it seems very probable that these abnormal hyphae are merely involution forms, due to 4 per cent. glycerine being an unfavourable culture medium (compare page 3). After nine months numerous black spots were visible in the mycelium: microscopic examination showed that these were centres at which olive green conidia (Pl. II, fig. 10) were being budded off from, or intercalated in, the hyphae of the mycelium: these conidia were similar in appearance and behaviour to those previously mentioned as occuring in exhausted hanging-drop cultures, and like them when transferred to small wooden block cultures were capable of infecting and thriving on the wood. In the malt gelatine flask and tube cultures a luxuriant growth of white mycelium appeared, which in four weeks liquified the whole of the culture medium (3 cms. deep): but here the mycelium formed a dense felt-work on the top of the liquid, instead of permeating the whole of it as in the gelatine cultures: also, in marked contrast to the continued oidial formation seen in the gelatine cultures, no oidial devolopment could be detected. No sporophore formation appeared; but after eight months numerous small round black patches, 2 or 3 mm. in diameter, appeared on the surface of one culture, and when these were examined microscopically they proved to be centres at which were being budded off olive green conidia, similar to those already mentioned. The frequent occurrence of olive green conidia suggests that perhaps this stage of the fungus may be identified with some species of the genus *Cladosporium*—one of the Hyphomycetes.

2c. *Wood block Cultures.*—Cultures were made on small blocks of wood (3.5 cm. × .9 cm. × 2 cm.), cut from large blocks of heart wood of oak, ash, alder, horse-chestnut, larch, pine, mountain ash, birch, elm, and sycamore.

The method used was that devised by Marshall Ward[1] for cultures of *Stereum hirsutum*: the blocks, after being soaked in cold water for a few hours, or boiled for a short time, in order to be made thoroughly sodden, were placed in short glass cylinders (15 cm. × 3 cm.) plugged at each end with sterilized cotton wool (Pl. I, fig. 11). After heating three times in a steam sterilizer, they were then placed upright in large glass beakers; the upper plug was momentarily re-

[1] Marshall Ward, On the Biology of *Stereum hirsutum*. Phil. Trans. Roy. Soc., 1897, vol. 189 B, p. 123.

moved, and spores from a spore deposit were transferred to the block by means of a sterilized platinum wire. In the *Stereum hirsutum* cultures of Marshall Ward, instead of spores, mycelium from a gelatine culture was transferred to the culture block. The cultures were kept moist by pouring a few cubic centimetres of tap water into the beaker supporting the cylinders: the lower plug in this way was kept continually moist, and although the water used was not sterilized the cultures generally remained quite free from pollution by bacteria and other intruders. If the infection was successful, after about six or seven days a trace of white mycelium could be seen on the outside of the block; and this, extending in all directions, gradually produced a thin white felt-work, varying in thickness from a mere film to two or three millimetres; but only in very few cultures during nineteen months did it quite hide the wood substratum. Growth was best at a temperature of about 15° C.

Ash, mountain ash, horse-chestnut, sycamore, and birch were very readily attacked by the fungus, but alder, elm, and oak proved far more resistent, and often only after several attempts did these blocks yield to infection, and even then the fungus did not seem to thrive well. Larch and pine, and any wood protected on all sides by bark, resisted all efforts at infection: spores germinated on the blocks, and a filmy patch of mycelium could be distinguished after seven days, but there was no further growth. Spores would not germinate on blocks which had been soaked for a week in creosote. Three months after infection one or two very small creamy waxy-looking hemispherical bosses, covered with short hairs, usually made their appearance on the ash, sycamore, horse-chestnut and birch blocks, and colourless or yellow watery faintly acid exudations were frequently seen either on the bosses or near: some of the bosses attained a height of 4 mm., but more frequently were smaller. Occasionally the bosses extended, and so formed ridges, 6 or more mms. in length, with a height of $1\frac{1}{2}$ mms. Often, after a few weeks, these bosses and ridges turned brown, and no further development took place. Other bosses appeared, and this continued for months, and still there were no signs of a typical bracket form of fruit body; although it seemed highly probable that these bosses were efforts at fruit formation, since they were so very similar to the initial stage of a sporophore boss formed under natural conditions.

Several of the blocks were removed from the cylinders into more spacious sterilized damp glass chambers and placed either on cotton wool or sand, and in as bright a light as it was possible to obtain in the laboratory. This environment seemed a little more favourable, since

the next bosses that were formed were slightly larger, and here and there a boss developed with a depression just at the lower side of its apex, thus resembling the second stage of the sporophore formed under natural conditions (Pl. II, fig. 12*b*). This went on for five or six weeks, and still no true bracket form appeared. The covers were now left off the chambers, and no attempt was made to keep the cultures under sterile conditions.

It seemed very probable that as the cultures were so small an insufficient supply of nutriment might be the cause of no proper fruit formation ; so two of the culture blocks (ash and elm) were bound to large unsterilized blocks of the same wood, and placed in large glass damp chambers, while several others were placed out in the open among herbaceous plants, a fairly shady spot being chosen, since the time of the year was August. The large block with the culture of ash attached became infected within a few days, and within a month showed a luxuriant growth of mycelium creeping over it, radiating out in all directions, even to a distance of 5 or 6 cms. Its fan-like spreading mycelium greatly resembled a rich mycelial growth of *Merulius lachrymans*, but without the conducting strands so characteristic of the latter fungus. As yet no sporophore has appeared, and seventeen months have elapsed since the culture started, and nine months since it was attached to the large block. The block with the elm culture attached shows no external signs of infection. But the cultures which were put out in the open, under natural conditions, quickly responded to the change of environment, and one small newly-formed cream wax-like boss appeared on each of the three cultures, and on an ash block there appeared within ten days a very small bracket-shaped sporophore, measuring 7 mm. across, which showed all the characteristic features of *Polystictus versicolor*, and shed spores ; and this was seven months after the infection of the block (Pl. I, figs. 2 and 3). It seems probable, therefore, that in nature this fungus can develop from the spore to the fruit body stage in the course of a single season.

On the vertical side of the block a resupinate form, with pores shedding spores, was also formed. Microscopic examination of the block showed that fungus hyphae, to a greater or less extent, were to be found in every part ; but, nevertheless, on the whole it still remained hard, and there was no great destruction of wood except in the immediate vicinity of the fruit bodies, while there, holes could easily be scraped in the wood with the finger nail.

It may now be concluded that it was not a deficiency in the supply of nutriment, but the unnatural conditions of growth prevailing

in the laboratory, which prevented the formation of the sporophore. On another culture (mountain ash) six and a half months after infection, when it had been two months out in the open, a very small sporophore (5 mm. × 3 mm.) appeared. Lakon,[1] when recently repeating some experiments of Brefeld, found that the sporophore formation of certain *Coprini* was inhibited by a damp atmosphere ; but immediately a stream of air was allowed to pass freely through the culture tubes normal sporophores developed.

On the upper horizontal surface of an ash block, infected about the same date, there appeared a deformed sporophore which shed spores from pores formed on its upper surface. This also had just been ten days out in the open.

Although in all the hanging-drop cultures the mycelium produced from the spore passed through an oidial stage after about eight days, yet only in two instances was any trace of this form found on the many block cultures examined, and even then oidia certainly were not abundant.

Falck[2] considers the oidial form of mycelium as a form especially adapted for living in concentrated solutions, and the ordinary basidial mycelium as a form adapted best for growing on solid substrata, owing to (1) its especial power of dissolving the most resistent plant products, (2) its capacity for absorbing dilute solutions, (3) its conducting power. The culture experiments which have already been described certainly support this view, for in the hanging-drop cultures it was only when a lowering of the concentration of the drop took place, owing to the absorption of food material, that the oidial form passed over into the ordinary mycelial form : in the instances mentioned of oidia appearing on the block cultures, possibly the blocks were unusually sodden, and the spores germinated under conditions similar to those of a hanging-drop.

Some of the olive green conidia from a gelatine culture, and also from a glycerine culture, were transferred to a block : soon the whole of the exterior became covered with green conidia, and from some of these were formed hyphae (green and colourless) which penetrated the wood.

An attempt was made to infect branches of two living trees (birch and apple). A wedge-shaped slit was made in each branch, and a plentiful supply of spores then introduced and the slit bound up. Other branches, after being slit and bound up, were kept as controls. After

[1] G. B. Lakon, Die Bedingungen der Fruchtkörperbildung bei *Coprinus*, Bot. Zeit., Abt. 2, 16th Jan., 1908, p. 25.

[2] Falck, *l.c.*

four months these branches were examined. The spores had germinated, and had produced a very poor mycelial development, but had not penetrated the tissue; except in the case of the birch, where in several of the vessels close to the cut surface involution forms of hyphae had developed.

3.—Destruction of Wood.

On all the wood cultures, after a few weeks, the infected areas could very easily be distinguished by a change in colour which took place; for the progress of the mycelium is marked by its bleaching effect. This is very striking on the dark woods of elm and alder and cherry, but even the white wood of ash takes a paler hue. In this production of a "white rot" it somewhat resembles *Polyporus juniperinus*[1] and *Polyporus squamosus*.[2] Wood rotted by *Polystictus versicolor* is eventually so soft that a blunt knife will easily penetrate it, and by slight pressure between the fingers it crumbles up and looks like sawdust. If a piece be broken out of a large block and examined, it is seen that it readily splits into tangential flakes parallel with the annual rings, and that these flakes easily break up again into very small splinters parallel with the long axis of the log. The very white lines and small patches, seen especially on the surface of the flakes, are due to strands of white mycelium.

To gain more minute detail of how the fungus proceeds in its work of destruction the small wood culture blocks and also wood from very rotten logs were examined microscopically. Transverse and longitudinal sections soon revealed that the pitted ducts and medullary rays are the first objects of attack: the plugs of fine hyphae filling the vessels are well shown, both in transverse and longitudinal sections, and even in young cultures, on the dark wood of elm and alder, these could be traced with the naked eye as long white lines in the wood. The splitting of the wood into tangential layers parallel with the annual rings is now explicable, since it is in the spring wood that pitted ducts are most abundant, and thus this direction would prove the line of least resistance to fracture. A similar manner of fracture due to the same cause is seen in wood rotted by *Polyporus sulphureus*.[3] The gradual disappearance of the medullary rays is best

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[1] Von Schrenk, U.S. Dept. of Agric., 1900, Bull. 21. Two diseases of Red Cedar caused by *Polyporus juniperinus*.

[2] Buller, *l.c.*

[3] Von Schrenk, U.S. Dept. of Agriculture. Some diseases of New Eng. Conifers, Bull, No. 25, 1900.

seen in longitudinal tangential sections (Pl. II, fig. 8*a*), where all stages can be found, beginning with the initial one of corrosion of the walls, to the final stage of nearly a lenticular hole. In later stages the fibres round the vessels and medullary rays are also attacked, and signs of corroded walls riddled with holes, formed by the penetration of the fungus, are everywhere evident (Pl. II, fig. 8*e*). In the final stage the thickening layers of the walls of the fibres are almost entirely consumed, leaving only the middle lamella (Pl. II, fig. 7*d*); and cell contents everywhere are quite wanting. In all directions fungus-hyphae are to be seen ramifying everywhere and perforating walls, sometimes passing through the pits, though absence of these is no hindrance to the penetration of the walls (Pl. II, figs. 7, 8, and 9): in some places there was observed a swelling of the hyphae previous to the perforation of the cell wall (Pl. II, fig. 9), as if a storing of energy had taken place previous to the attack. Francz Drysen [1] notes among the Discomycetes a similar swelling of hyphae previous to penetrating walls, also Miyoshi [2] mentions the occurrence of a similar phenomenon during the penetration of a collodion membrane by *Botrytis cinerea*.

In two very rotten specimens (apple and mountain ash), from branches varying from 6 inches to 1 foot in diameter, a dark brown line marked the limits of the ravages of the fungus: it was due to the presence of brown oily-looking cell contents, probably decomposition products of a resinous nature, although only negative results were obtained when tests (Cu acetate solution, Ferric chloride solution, Rosaline violet and Am. molybdate and AmCl) were made for resin and tannin. This dark brown line, although similar in appearance to the black layer found in wood rotted by *Polyporus squamosus*,[3] or by *Trametes pini*,[4] is not of the same nature, for the latter is formed of mycelial tissue: but it bears a strong resemblance to the brown layers so often seen in transverse sections of sound wood taken from well-pruned fruit trees, which is said to be due to oxidation products; since pruning probably allows a freer access of air to the interior of the stem. Similarly wood penetrated by mycelium would doubtless receive a very abundant supply of air, hence the boundary limiting the attack of the fungus might well be defined by brown oxidation products.

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[1] Drysen, J. R.M. Soc., Apl., 1907.

[2] Miyoshi, Die Durchbohrung von Membranen durch Pilzfäden, Pringsh. Jahrb., 1895, vol. 28, p. 281.

[3] Buller, from a paper in preparation for the press.

[4] Von Schrenk, U.S. Dept. of Agriculture, 1900, Bull. 25.

The fungus hyphae are unable to penetrate bark except at the lenticels; hence it is always at a lenticel or place of injury that the first sign of the formation of a sporophore appears; and the bark is so resistent that it is quite possible to obtain a branch which has been rendered nearly hollow, owing to the consumption by the fungus of nearly all the interior.

The very marked change in specific gravity is apparent on handling the rotten wood, which, like most woods well rotted by fungi, feels particularly light in weight. The specific gravity of a block of dry mountain ash changed from .5 to .1, and of dry birch from .65 to .2.

4.—Chemical Changes in Rotting Wood.

It is very evident that side by side with these structural alterations great chemical changes take place in the composition of wood. The usual colour tests of phloroglucin and chlorozinc iodine were applied to microscopic and larger portions of sound and decayed wood. With phloroglucin and HCl the rose-red colour was certainly far less pronounced in the rotten than in the sound wood, and in wood in the last stages of decay, whatever fragments of medullary rays did remain were only very faintly stained; so this is evidence that the fungus removes to some extent the substances, whatever they may be, which cause the so-called lignin reaction. With chlozinc iodine all the elements of both sound and rotten wood stained a beautiful golden brown: now although it might be said, judging from the phloroglucin test, that delignification had taken place, yet no violet colouration indicating the presence of uncombined cellulose could be detected. A few very faint traces of violet colouring were to be seen in fragments of medullary rays of rotten wood after staining for forty-eight hours. Although the substance hadromal, which was first isolated by Czapek,[1] gives the phloroglucin reaction, yet it does not seem quite justifiable to infer that the absence of colouration on applying the phloroglucin test is conclusive evidence that that aromatic aldehyd has been abstracted by the fungus; since many other aromatic compounds have a similar reaction with phloroglucin and HCl.

Also knowing that some unlignified cell walls give the phloroglucin test this colour reaction is hardly a conclusive proof of the presence or absence of lignification. Since colour tests cannot be relied upon, the difference between altered and unaltered wood can hardly be satisfactorily explained without actually isolating and estimating

[1] Czapek, Biochemie der Pflanzen, vol. i., p. 571.

quantitatively the different substances composing the woody tissue — a by no means simple task even in the hands of an experienced chemist, since on the subject of a chemical nature of wood there are still very many differences of opinion. A reference either to Czapek's [1] or Wiesner's [2] summary of the subject, shows that although many substances have been isolated, concerning some it is a matter of much uncertainty whether the substance existed as such in the wood or was merely some compound formed during the chemical reaction.

Von Schrenk,[3] in the course of his investigation of the red rot caused by *Polyporus carneus*, obtained by abstracting finely rasped cedar wood with absolute alcohol for six hours in a Soxhlet's extractor, a substance which he considered identical with hadromal.

Similar extractions were carried out, using finely divided sound and decayed wood. 5.4 gms. of sound fine birch sawdust was extracted with 150 cc. of absolute alcohol for nearly sixteen hours: the extract when tested with phloroglucin and HCl assumed the deep rose-red colour characteristic of lignin, and also of hadromal, and when evaporated down left a brown gummy deposit, in which, when examined microscopically, could be seen a few white transparent needle-shaped crystals, which may have been those of hadromal.

When this experiment was repeated, using decayed instead of sound birch, the extract did not give the phloroglucin reaction, although on being evaporated down a similar gummy deposit remained.

Since according to Potter [4] some of the delignification of wood attributed to fungi has really taken place during the sterilizing process, it was thought well to see to what extent this might possibly have been the case in the small blocks such as were used for the wood culture experiments. 5.4 gms. of birch sawdust (a little culture block weighed about 5.4 gms.) was distilled with 150 cc. of water for twenty hours: the extract did not give the phloroglucin reaction: it was evaporated down, and the brown gummy deposit obtained was redissolved in 3 cc. of water: this liquid gave a very faint rose-red colour when tested with phloroglucin and HCl. Hence, since steaming of wood in a finely powdered state for twenty hours, produces in the extract after concentration only very slight evidence of delignification, the delignification which would take place in a solid block during sterilization (at most $2\frac{3}{4}$ hours steaming) must be very insignificant.

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[1] Czapek, *l.c.*

[2] Wiesner, Die Rohstoffe des Pflanzenreiches, 1900.

[3] Von Schrenk, U.S. Dept. of Agriculture, Bull. 21, p. 17, 1900.

[4] Potter, Ann. of Botany, 1904, On the occurrence of Cellulose in the Xylem of Woody stems.

Spaulding[1] considers that Potter's statement concerning this delignification produced by steaming should generally be modified somewhat.

Since wood is known to contain about 20 per cent. or more of xylan or wood gum, an attempt to extract this substance from sound and rotten birch wood was made. Following the method used by Okmura,[2] 2.5 gms. of sound birch wood sawdust was added to a flask containing 25 cc. of 5 per cent. of KHO solution, and after corking up left untouched, except for an occasional shaking for twenty-four hours: a similar mixture was made, using rotten wood instead of sound: on filtering a clear brown extract was obtained from both flasks, the rotten wood extract being the darker of the two. Both extracts were now neutralized with dilute HCl, until only a very slight acid reaction was perceptible: a copious cream precipitate of xylan came down in the sound wood extract, whereas in the other extract only the merest trace of a turbidity was to be seen. After filtering and drying and estimating the increase in weight of the two filter papers, it was found that the wood gum extracted from the 2.5 gms. of decayed wood was only 50 mgs., compared with 150 mgs. from the sound. Taking into consideration that decay in birch wood brings about a reduction of specific gravity from .65 to .2, the figures showing the amount of wood gum extracted from equal volumes of decayed and sound wood would show a far greater contrast. In a similar experiment, with similar results, alcohol instead of dilute HCl was used to precipitate the wood gum.

It is well known that conifers are exceedingly poor in wood gum, hence possibly to this cause may be assigned their immunity to infection by this fungus: on the other hand birch, which contains as much as 26 per cent. of xylan, falls an easy prey.

5.—The Sporophore.

The first sign of the sporophore formation is the appearance of a minute rounded white knob, about the size of a pin head, either at a lenticel, crack, or the cut or broken end of a branch: this knob gradually increases in size until it stands out about 4 or 5 mms. from the bark (Pl. II, fig. 12*a*). A horizontal groove (Pl. II, fig. 12*b*) now appears across the apex of the knob, and in the course of the next twenty-four

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[1] Spaulding, Missouri Bot. Gard., 17th Report, 1906. Studies on the lignin and cellulose of wood.

[2] Okmura, Imp. Univ. of Japan, Coll. of Agric., Bull. 2, 1894-97. Wood Gum in trees (Xylan).

hours the bracket form is made much more pronounced by the greater growth of the upper half of the knob-like structure forming the pileus (Pl. II, fig. 12*c*): at the same time there is a slight flattening of its upper surface, and on the lower can be seen four or five very shallow pits, which ultimately develop into hymenial tubes (Pl. I, fig. 10): under favourable conditions this stage is reached in five or six days. The part below the groove either ceases growth or extends radially over the bark, and often unites with the bases of other sporophores formed below or at the sides: its exposed surface becomes dotted over with pit-like depressions, which on further growth become grooves: the pileus develops into the semi-circular zoned structure already described, and grows by additions to its margin (Pl. I, fig. 9). At the same time the pits which cover the under surface to within .5 mm. of the margin develop into hymenial tubes: the thickness of the pileus varies from about 4 or 5 mms. behind where the tubes are formed to 1 mm. or less at the margin where there are no tubes. The hymenial tubes vary in depth from 1.5 or 2 mm. to mere depressions: very long tubes, of a depth of even 5 mm. or more, are sometimes formed.

The rate of growth of the pileus varies according to temperature and supply of moisture. With a temperature of 60° F. and a saturated atmosphere—highly favourable conditions for growth—an average of 1 mm. a day is attained: at a lower temperature of 50° F. the average growth does not exceed .5 mm. a day, and at a temperature whose maximum and minimum does not vary much from 40° F. the growth is very slow, 1 mm. in five or six days. During frosty weather growth is entirely arrested. A sporophore takes about six months to complete its growth; but it is difficult to know when this final condition is reached, for growth is often arrested for a month or six weeks at a time when conditions are unfavourable: also injuries by beetles, and probably birds and rodents, who find it a convenient source of food, will cause sporophores to stop growing.

The zoning of the pileus seems due chiefly to an alternate checking or promotion of growth caused by changes in the amount of moisture, this of course being dependent on varying atmospheric conditions. A sporophore-bearing branch of birch was arranged with one end dipping in a few cubic centimetres of water in a beaker; this was placed in a dish also containing a little water, and the whole was covered with a bell jar; the temperature did not vary more than a few degrees from 15° C. Hardly any signs of zoning could be traced on the pilei which developed under these conditions, and the velvety surface instead of having the usual ribbed appearance was quite even. Occasionally the bell jar was left off for an hour, and even this slight

exposure to a drier atmosphere was sufficient to cause a check in the growth, and hence a marked zone in the pileus. Pilei growing on logs in fields and woods were watched and measured at intervals of a few days, and always after a period of drought, during which growth was quite or nearly arrested, a distinct furrow or zone marked the end of the old zone and the beginning of the new: sometimes when the period of drought had been prolonged a week or more, in a vertical radial section through the pileus the division line could be seen, extending nearly to the hymenial surface. When atmospheric conditions were unfavourable to growth, the hairs forming the velvety surface were either exceedingly short or none were developed; hence a period of drought was marked by a furrow. The faint zoning which occurs when apparently there has been no great change in the humidity of the air is doubtless due to the check in growth which takes places at night owing to a fall of temperature.

The colouring, which to some extent intensifies the zoning, is dependent on light: it is due to the presence of a diffuse yellowish pigment, which on exposure to light gradually changes into sepia brown granules. When the sporophore makes its first appearance it is always white, as is also any new growth which takes place at the margin of the pileus: after three or four days a pigment is developed in the hairs which cover the upper part of the sporophore, and also in the surface strands of hyphae from which these hairs arise: these pigment granules cause the hairs and superficial hyphae to vary from buff to dark brown, according to the intensity of light. The sporophores grown in the diffused light of the laboratory, under uniform conditions of temperature and moisture, were a uniform pale buff colour: only very rarely was a zone emphasized by a slight deepening of colour, and any zoning that did occur was only very faintly marked, and could be accounted for by differences of day and night temperature.

Sporophores which developed in the open on the lower side of a huge log, shaded by over-arching trees, also had pale buff upper surfaces; but the zoning was well marked, since the variable atmospheric conditions had been responded to by variations in the growth of the hairs. On the same log the sporophores which grew on the top, and on the under side, where they were exposed to a greater intensity of light, developed quite normally, and the buff colour soon changed to the darker brown shade. If growth is checked rather quickly, the margin of that zone of growth, owing to a deficiency in the formation of pigment, is marked by a lighter band; hence the pilei formed in summer, when periods of drought are more frequent, and growth is

often arrested suddenly, generally have many golden brown bands marking these periods.

This yellow pigment is at first diffused through the sap; but later on, when it changes to the darker sepia brown shade, it takes a granular form, and then the hairs and superficial hyphae have the appearance of thick-walled tubes containing a core of sepia brown granules. It is only the fairly young zones of a pileus which show these conspicuous coloured bands, for ultimately the whole surface acquires the same dark colour; and the banded appearance seen then is due only to the differences of texture presented by the velvety ridges and satiny furrows, which become even more conspicuous when the pileus, on becoming quite dry, has the well-known grey appearance. A pale buff-coloured pileus, when once detached from its host and allowed to dry for some weeks, is incapable of developing the darker pigment when exposed again to ordinary atmospheric conditions.

This dark brown pigment is unaltered by H_2SO_4, HCl, or ammonia, but nitric acid changes the colour to brick red: it is slightly soluble in absolute alcohol.

The green zones so often seen are caused by the presence of colonies of *Pleurococcus vulgaris* [1] and *Stichococcus bacillaris* [1] among the hairs on the surface of the pileus.

The biological significance of these velvety hairs, which also occur on the upper surface of the pilei of many species of fungi, is a matter of doubt. According to Buller [2] they form a kind of capillary system for the purpose of rapidly spreading any drops of water which may fall on the pileus; and certainly a drop of water let fall on a pileus does disperse almost instantaneously. Or, they may be of the same use as the hairs of many xerophytic plants, which are in this way afforded protection against rapid desiccation; and in support of this it may be mentioned that a pileus stripped of its hairy surface dries up far more rapidly than it otherwise would do.

Microscopic examination of a pileus showed that it consisted of a densely-woven felt-work of branching septate hyphae, radiating from the attaching base. At the upper horizontal surface many hyphae became free, and formed the characteristic long pigment-containing hairs: other hyphae grew vertically downwards, and formed the hymenial tubes. Some of the largest hyphae measured $3.7\,\mu$ in diameter. The hymenial tubes were lined by club-shaped basidia (Pl. ii, fig. 11), from each of which were developed four spores attached to the ends of rather long sterigmata.

[1] Kindly identified by Mr. Geo. S. West, M.A.

[2] Buller, in a communication to the Royal Society, not yet published.

Basidia are produced, and spores shot off from the sterigmata, immediately the hymenial tubes begin to form; the tubes always grow vertically down, so that the openings are usually round, but they may be oval, or even groove-like, if the tubes arise from an oblique or nearly vertical part of the pileus.

6.—Reactions of the Fruit Body to Light and Gravity.

Light and gravity play a very important part in determining the development and direction of growth of the fruit bodies of many fungi—of *Polyporus squamosus*, *Lentinus lepideus* and others, so that it is not surprising to find that the combined action of the two stimuli is necessary for the formation of a properly formed fruit body in this case also.

Two small branches of birch, with fruit bodies already developing on them under normal conditions, were brought into the laboratory and placed in similar damp chambers: one was placed in the dark room, and the other, kept in the light, was used as a control. The already-formed fruit bodies ceased to grow, and in the course of a month several new ones began to develop on both branches, and in addition, on the control branch a small fruit body developed on the edge of an old pileus. These observations were continued for nine months, and never during that time did a proper bracket form of pileus appear on the branch in the dark chamber. Large numbers of white wax-like bosses, which grew to an abnormally large size, were developed over a long period, and after assuming a creamy or greyish velvet-like appearance ceased to grow (Pl. I, fig. 4). Some of these large bosses were from 1.3 to 1.5 cms. in diameter, and projected out 1.6 cms., while normal ones never measured more than one-third of these dimensions. A few of the bosses became slightly depressed at the apex, but no trace of any pore or tube formation was seen. When this branch was moved into a light chamber new bosses continued to form, but these developed into typical fruit bodies in the course of a few days (Pl. I, fig. 5). None of the bosses which had been formed in the dark grew into pilei, no matter the stage of development at the time of the change from darkness to light. On the control branch the small wax-like bosses developed into small normal bracket-like sporophores, but these were paler in appearance and had their zoning less marked than similar fruit bodies grown out in the open air. This experiment points to light being the controlling factor in determining sporophore production; but then no account has been taken of the action of gravity—the importance of which is seen in the results of the following experiment.

Two small mountain ash branches very similar to the above, bearing normally developed fruit bodies, were arranged horizontally, one on a clock-clinostat,[1] the other as a control. Here an environment more nearly approaching a natural one was secured by allowing the branch on the clinostat to project through a hole in the laboratory window, thus while the clock work of the clinostat was protected, the branch had all the advantages of ordinary atmospheric conditions. To obtain a further and more continuous supply of moisture than the rather exposed, and thus dry, situation afforded, an apparatus was made for allowing two drops of water to fall on the branch every three or four minutes, and this was connected by means of a syphon with a small tank of water in the laboratory. The control branch was fixed to the window woodwork a little below the other, and shared in the falling drops of water. The branch on the clinostat rotated three times every hour, and the experiment was continued for seven months; but never during this period did a typical bracket-shaped fruit body form: small white waxy bosses appeared, which spread irregularly in all directions, and sometimes united with one another: these formed eventually an incrustation over the surface of the branch with a rough irregular surface and curled up edges (Pl. I, fig. 6). The white waxy bosses soon turned cream colour and showed signs of a pore formation on the exposed surface, while the surface next to the bark assumed the velvety zoned appearance so characteristic of the upper surface of a normal pileus; a small piece of the pore-bearing part, laid on a glass slide for an hour, yielded a good supply of spores. On the control branch a well-developed series of imbricate sporophores appeared.

Taking into consideration these two experiments, it seems quite evident that the dimidiate form of the sporophore is not to be ascribed either solely to the stimulus of light, nor yet to that of gravity, but to the combined action of both, while it is very evident the formation of pores, and thus of spore production, is a response to the one force only—that of light.

7.—*Polystictus versicolor* AS A XEROPHYTE.

An observation will now be described indicating that the mycelium of *Polystictus versicolor* can retain its vitality for at least four years.

A large branch of privet (*Ligustrum vulgare*) with fruit bodies of *Polystictus versicolor* upon it, collected four years previously, was taken from the Botanical Museum, where it had been kept dry. The temperature to which it had been subjected varied from about 10° C. in the winter to 19° C. in the summer. The branch was sawn into two

[1] Bayliss, Galvanotropism of Roots, Ann. of Botany, 1906, p. 389.

parts, one part with the fruit bodies on it and the other without. The branches were soaked for a day in a large vessel of water, and then placed in a damp chamber (50 cm. × 50 cm. × 50 cm.) and kept watered. In the course of a week the bark became covered with a mycelium: this belonged to various moulds, which on fruiting were identified. Just under a month from the date of soaking a number of small cream-coloured wax-like bosses appeared, studding the surface of both branches; from many of them hung pale yellow watery exudations, faintly acid to litmus. After a week or two several projected as far as 6 or 7 mms. from the bark, and also showed indications of the bracket form of pileus characteristic of *Polystictus versicolor*; but on reaching this stage these imperfect sporophores turned brown and ceased growth: these were followed by other similar wax-like bosses, which on reaching the same stage also died. One of the branches was now put out in the open on damp moss, and in a few weeks normal dimidiate sporophores developed on it. The branch left in the laboratory, in about three months from the date of its removal from the museum, produced an abnormal bracket form of fruit body with pores on the upper surface; also another strange-looking structure—a series of five or six undeveloped brackets, growing one out of the other, and projecting like a rod (Pl. I, fig. 8). The light in the laboratory in which these were growing is not good in the darker months of the year, so this may account to some extent for these abnormalities; a few weeks later, as the days grew lighter, in February, a proper typical well-developed sporophore, with concentric zoning, velvety surface and tubular hymenium appeared (Pl. I, fig. 7). It is very evident that the mycelium of *Polystictus versicolor* must retain its vitality after prolonged and continuous desiccation: in the above instance, in four years the mycelium had not died. The contention might be raised that stray spores of *Polystictus versicolor* on the bark had germinated, and in this way the branch had been reinfected; but such an explanation can hardly hold good if one calls to mind the small block culture experiments which have already been described in detail, and remembers that the first sign of sporophore production did not appear until at least three months after infection; and even when typical sporophores did appear, they were only of very small dimensions. Yet another explanation might be urged: since oidium-like cells have been seen among the hyphae in wood vessels, may not these cells be adapted to resist prolonged drought just as spores are? But then again they were not by any means abundant in the dry specimens of rotten wood examined, so it is hardly to be believed that the mycelium, which was in a good fruiting condition within a month of the dried branch being

placed under damp conditions, was developed solely from these structures. This instance of great vitality in mycelium is not without a parallel case, for Falck [1] mentions that horse dung infected with the mycelium of *Coprinus sterquilinus* was capable of infecting other cultures after being kept perfectly dry for a year. Again, the blocks of ordinary mushroom spawn sold in shops are usually quite dry, and probably have been kept so for long periods, and still the mycelium retains its vitality. Since mycelium possesses this power of retaining its vitality, even after four years' drying, it is evidently highly important that timber used for economic purposes should be well tested as to its soundness, and if possible some sterilizing treatment adopted before using, otherwise any access of moisture would cause a further development of the fungus and renewed rotting of the wood. Often in the course of this investigation block after block of apparently sound hard wood, especially birch, had to be discarded, because on being examined microscopically it was found to be already infected. Of course, the sterilizing process would have prevented any of the mycelium developing further, but any blocks thus affected would have been vitiated for microscopic examination afterwards.

Buller [2] has made known the fact that very many of the leathery and woody forms of sporophores, such as *Polyporus*, *Daedalia*, *Fomes*, etc., after prolonged drying, are capable when moistened of reviving and shedding spores again: in some instances, the sporophores which revived had been dry for several years. The sporophores of *Polystictus versicolor* also possess this power of reviving: sporophores which had been dried for sixteen months, and were perfectly hard and rigid, on being thoroughly moistened revived in $3\frac{1}{2}$ hours. And apparently the same sporophore is capable of reviving again and again after drying and becoming quite hard, for several which were tested revived as many as six times. But specimens four years' old, removed from the branch whose mycelium revived, had lost their vitality entirely.

Under natural conditions the hymenial surface of the pileus does not often last longer than a few months owing to the ravages of a little beetle (*Cis boleti*, Scop.), which delights in consuming its substance, whether moist or dry. Even gathered sporophores, unless special care had been taken to pick only perfectly sound ones, after a few months will be found entirely consumed with the exception of the velvety upper surfaces.

The spores also retain their vitality for long periods. Spores

[1] Falck, *l.c.*, p. 317.

[2] Buller, in a communication to the Royal Society, not yet published.

which were kept in the laboratory for eleven weeks always germinated, although drying delayed the germination somewhat longer than the usual period of twenty-four to forty-eight hours: those which had been dried for seventeen weeks would not germinate.

The spores are also capable of germination after exposure to high and low temperatures: those which had been in a temperature of 41° C. for three days germinated in three days, and they also germinated after being exposed for half an hour to a temperature of 75° C, but were not able to survive a temperature of 100° C. After being kept for three days at a temperature of 0° C. in the ice chest of the Chemical Department, spores germinated two days later than those of the same spore deposit kept at ordinary laboratory temperature, but they would not germinate after being frozen for three weeks.

8.—Enzymes.

The life-history of a fungus would be very incomplete without some reference being made to its enzymes, for doubtless the gradual decay which a fungus causes in sound wood is to be attributed to the activities of these secretions, in the preparation of easily assimilable food material for the fungus plant. Although in recent years enzymes have received much attention from many investigators the records of their occurrence in fungi are far from numerous.

By means of the usual tests on an extract of *Polystictus versicolor* the presence of laccase, rennetase, cytase, invertase, diastase, coagulase, ereptase and a fibrin digesting protease was demonstrated. Only negative results were obtained on testing for emulsin, lipase, maltase and hadromase.

9.—Conclusion.

In conclusion, I must express my thanks to Professor Hillhouse for the kindly assistance he has rendered me in many ways in the course of this work; and also my indebtedness to Professor Buller, both for the subject of this investigation and for the very many helpful suggestions he has given me in carrying it out; and to Professor Adrian Brown for loan of apparatus and material. My thanks are also due to Mr. Herbert Stone for identifying the wood experimental blocks, to Mr. Stoward, M.Sc., for help in the enzyme section of this work, and to Mr. W. B. Grove, M.A., for the identification of some of the fungi.

University Botanical Laboratory,
Birmingham,
March, 1908.

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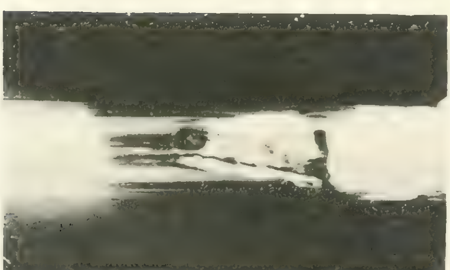

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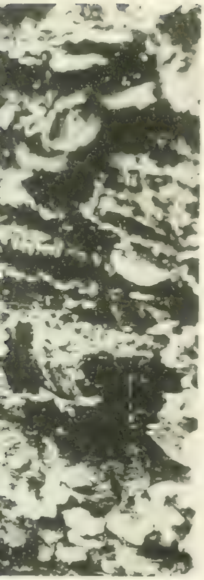

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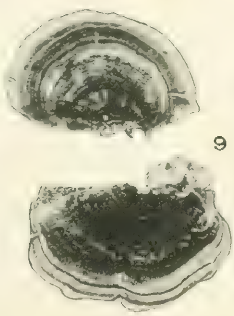

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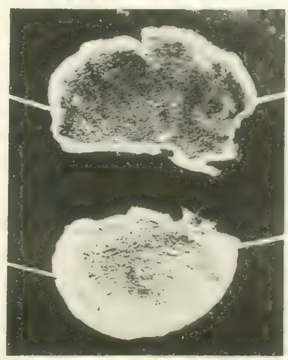

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Huth, London.

COLOR (Fries).

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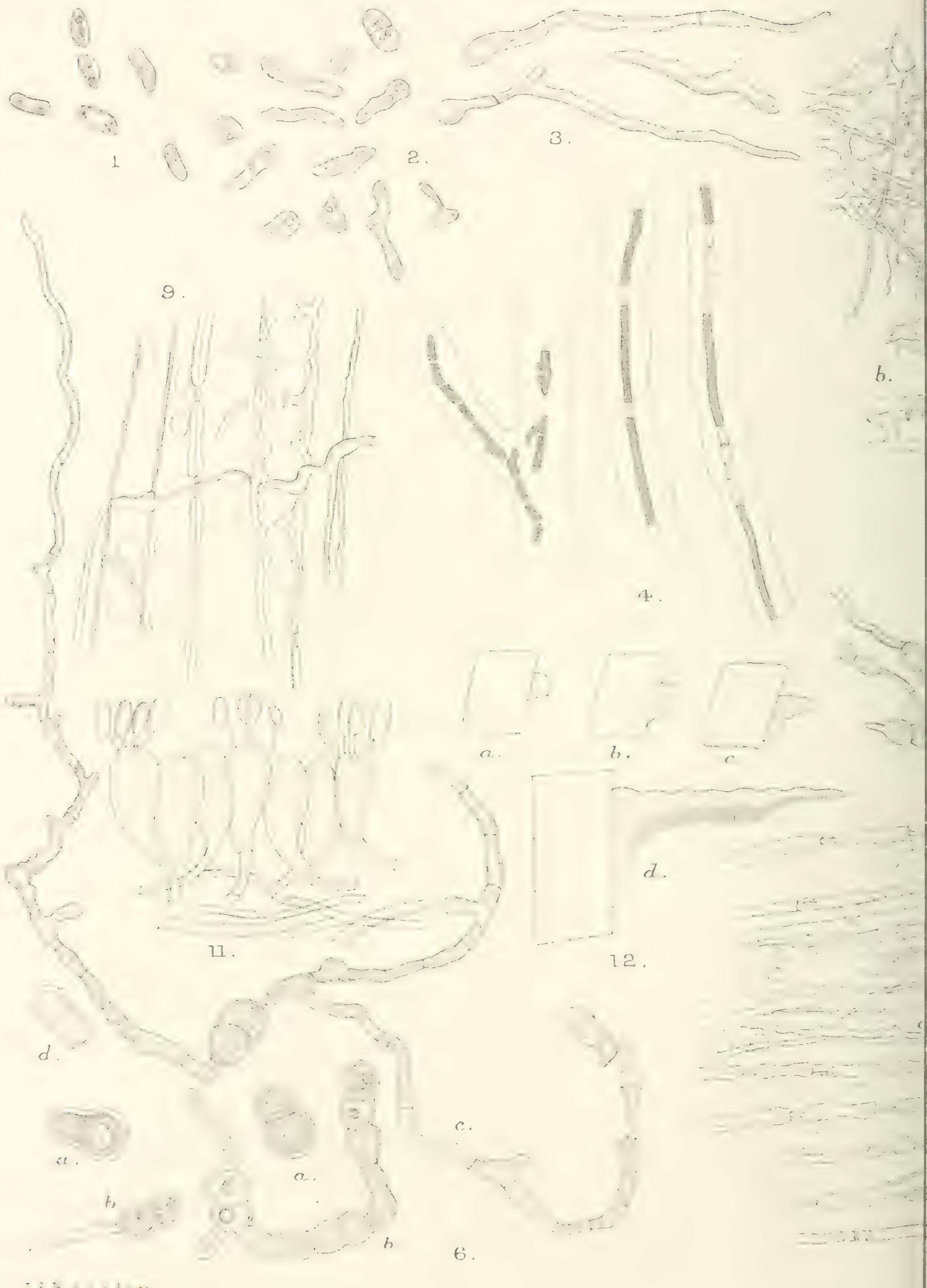

POLYSTICTUS V

Pl. I.

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ICOLOR (Fries).

EXPLANATION OF PLATES I AND II,

Illustrating Miss Jessie S. Bayliss' paper on "The Biology of *Polystictus versicolor* (Fries)."

Plate I.

Fig. 1.—Sporophores of *Polystictus versicolor* growing on a mountain ash log in Sutton Park, 1907.

Fig. 2.—Sporophore grown from spores on a small block of ash.

Fig. 3.—Hymenial surface of the sporophore in fig. 2 : the large hole was made by a small beetle.

Fig. 4.—Large sporophore bosses on a branch which has been kept in a dark room for nine months. No trace of hymenium to be seen.

Fig. 5.—The same branch as in fig. 4, a week after being in the light : hymenial surfaces have developed.

Fig. 6.—Abnormal sporophores formed on a branch while revolving on a clinostat : the cork disc and spindle were used for attaching the branch to the clinostat.

Fig. 7.—Pileus (slightly enlarged) developed on rotten branch from mycelium which had retained its vitality for four years in a desiccated condition : numerous young sporophore bosses are visible.

Fig. 8.—The horizontal rod-like structure is a series of sporophores growing one out of the other.

Fig. 9.—Upper surfaces of fruit bodies of *Polystictus versicolor* showing zoning.

Fig. 10.—Lower surfaces of fruit bodies of *Polystictus versicolor* showing the pores of the hymenial tubes.

Fig. 11.—Culture tube containing a wood block which is partly covered with mycelium and on which a young sporophore boss has developed.

Plate II.

Fig. 1.—Freshly fallen spores. × 800.

Fig. 2.—Germinating spores after forty-eight hours in tap water. × 800.

Fig. 3.—Germinating spores twenty-four hours later than in fig. 2. × 800.

Fig. 4.—Hyphae from spores grown in malt-gelatine breaking into oidia : the hyphae have liquified the malt-gelatine in their vicinity. × 800.

Fig. 5.—(*a*) Conidia budding from exhausted hyphae. × 1000. (*b*) Germinating conidium with a large glistening drop in the centre.

Fig. 6.—(*a*) Two-celled olive green conidia. (*b*) Germinating conidium. (*c*) Germinating conidium a few days older than (*b*). (*d*) A two-celled conidium surrounded by a rough wall.

Fig. 7.—Transverse section through rotten mountain ash wood. × 800. *a*, *a*, *a*, are vessels blocked with fungus hyphae. *b* is an almost entirely

consumed medullary ray. *c*, *c* are destroyed vessels. *d*, *d*, *d* are walls consumed except for the middle lamella. Corroded walls are everywhere apparent.

Fig. 8.—Tangential section through rotten mountain ash wood *a*, *a*, *a* are nearly consumed medullary rays. *b* is a hypha passing through a pit, *c*, another penetrating a wall. *d* is a large hole made by a fungus hypha. *e*, *e* is a corroded wall. Enlarged pits are very numerous

Fig. 9.—Section shewing swelling of hyphae previous to penetrating walls.

Fig. 10.—Olive green conidial cells and wide hyphae from the black specks in the glycerine culture. × 800.

Fig. 11.—A portion of the hymenial layer showing basidia and spores.

Fig. 12.—*a*, *b*, *c*, and *d* are sections showing successive stages in the development of a sporophore. Natural size.

REVIEWS AND CURRENT LITERATURE.

I.—General Subject.

Howard, L. O.—The Recent Progress and Present Conditions of Economic Entomology. Science, 1907, n.s. vol. xxvi, pp. 769-791.

This is a most interesting review of the progress that has been made since 1894 in economic entomology. To collect the necessary information from all parts of the world must have been no easy task, and whilst we fully agree with Dr. Howard that "official recognition of this science in Great Britain is slight," there is much more work being done than Dr. Howard seems to be aware of. We find no mention of the excellent work of Dr. R. Stewart MacDougall, in Scotland; of the Department of Economic Zoology in the University of Manchester; Mr. Cecil Warburton's work in connection with the Royal Agricultural Society; or that being carried out by The Cooper Research Laboratory.

Morgan, H. A.—The Relation of the Economic Entomologist to Agriculture. Journ. Econ. Entom., 1908, vol. i, pp. 11-15.

Sanderson, E. D.—The Relation of Temperature to the Hibernation of Insects. Journ. Econ. Entom., 1908, vol. i, pp. 56-65, 2 figs.

Westell, W. P.—The Insect Book. Pp. xii. + 120, 36 figs. By R. B. Imisson. London: John Lane. [1908]. Price 3/- net.

This dainty little brochure is one of Mr. Lane's "Country Handbooks" series. At the present time there seems to be a demand for nicely illustrated books, such as this, treating on insects and insect life.

The illustrations are certainly good, but we must confess that we cannot understand anyone who wishes to learn anything about insects turning to such a work as this, when, for a few pence more, he or she can obtain a work like Professor Carpenter's "Insects, their Structure and Life," and possess an excellent and entertaining guide.

We do not say this as in anyway derogatory to Mr. Westell's little work, which is written in an entertaining style, and will no doubt be widely read.

After an introduction, full of interesting facts, the author considers the commonest forms of insects of the garden, the water-side, the woodland, of meadows, heaths, and lanes, and household insects.

W. E. C.

II.—Anatomy, Physiology, and Development.

Barber, C. A.—Studies in Root Parasitism. The Haustorium of *Olax scandens*. Mem. Dept. Agric. India, Bot. Ser., 1907, vol. ii, No. 4, pp. 1-47, plts. i-xii.

Bugnion, E.—Polyembryony and the Determination of Sex. Ann. Rpt. Smiths. Inst. for 1906. Washington: 1907, pp. 309-320.
A résumé of the observations of P. Marchal.

Nieden, F.—Der sexuelle Dimorphismus der Antennen bei den Lepidopteren. Zeit. f. wiss. Insekten., 1907, Bd. iii, pp. 114-117, 137-143, 165-174, 198-203, 242-247, 39 fign.

III.—General and Systematic Biology, and Geographical Distribution.

Adkin, R.—Life history of *Tortrix pronubana*. Entom., 1908, vol. xli, pp. 49-51, plt. ii.

Cerva, F. A.—Biologie der *Eilicrinia cordiaria*, Hb. Zeit. f. wiss. Insekten., 1907, Bd. iii, pp. 53-56, 1 fig.

Cholodkovsky, N.—Zur Biologie von *Scardia tessulatella*, Zell. Zeit. f. wiss. Insekten., 1907, Bd. iii, pp. 78-83, 6 fign.

Donisthorpe, H. St. J.—The Life-History, and Occurrence as British of *Lomechusa strumosa*, F. Trans. Entom. Soc. Lond., 1907, pp. 415-420, figs. 1-6.

Eichelbaum, F.—Die Larven von *Cis festivus*, Panz., und von *E. phylus glaber*, Gyll. Zeit. f. wiss. Insekten., 1907, Bd. iii. pp. 25-30, 8 fign.

Escherich, K.—Neue Beobacktungen über *Paussus* in Erythrea. Zeit. f. wiss. Insekten., 1907, Bd. iii, pp. 1-8, 2 fign.

Felt, E. P.—Observation on the Biology and Food Habits of the *Cecidomyiidae*. Journ. Econ. Entom., 1908, vol. i, pp. 18-21.

Fiebrig, K.—Eine Ameisen ähnliche Gryllide aus Paraguay. Zeit. f. wiss. Insekten., 1907, Bd. iii, pp. 101-106, 10 fign.
Myrmegryllus dipterus, n. gen. et sp.

Hättich, E.—Ueber den Bau der rudimentären Mundwerkzeuge bei Sphingiden und Saturniden. Zeit. f. wiss. Insekten., 1907, Bd. iii, pp. 229-242, 261-272, 10 fign.

Hewitt, C. Gordon.—On a new Phytophagous Mite, *Lohmannia insignis*, Berl. var. *dissimilis*, n. var., with notes on other species of economic importance. Mem. and Proc. Manchester Lit. Phil. Soc., 1908, vol. lii, pp. 1-10, 1 plt.

Hooker, W. A.—Life History, Habits and Methods of Study of the *Ixodoidea*. Journ. Econ. Entom., 1908, vol. i, pp. 34-51.

An important and interesting paper.

Huber, J.—The Founding of Colonies by *Atta sexdens*. Ann. Rpt. Smiths. Inst. for 1906. Washington: 1907, pp. 355-367, plts. i-v.

Hunter, W. D.—A Tentative Law relating to the Incubation of the eggs of *Margaropus annulatus*. Journ. Econ. Entom., 1908, vol. i, pp. 51-55.

Leonardi, G.—Notizie sopra alcune cocciniglie dell' Isola di Giava raccolte dell Prof. O. Penzig. Boll. Lab. Zool., R. Scuola Sup. d'Agric. Portici, 1907, vol. i, pp. 97-116, 38 text figs.

Leonardi, G.—Notizie sopra una cocciniglia degli agrumi nuova per l'Italia (*Aonidiella aurantii,* Mask.). Ibid., pp. 117-134, 20 text figs.

Leonardi, G.—Contribuzione alla conoscenza delle cocciniglie italiane. Ibid., pp. 135-169, 61 text figs.

Martelli, G.—Contribuzione alla biologia della *Pieris brassicae,* L., e di alcuni suoi parassiti ed iperparassiti. Ibid., pp. 170-224, 12 text figs.

Martelli, G.—Di alcuni parassiti dell' *Ocnogyna baeticum,* Ramb., osservati nei dintorni di Catanzaro. Ibid., pp. 225-230.

Masi, L.—Contribuzioni alla conoscenza sei Calcididi italiani. Ibid., pp. 231-295, 47 text figs.

Masi, L.—Contribuzioni alla conoscenza degli insetti Dannosi all' Olivio e di quelli che con essi hanno rapporto. Ibid., 1908, vol. ii, pp. 185-194, 6 text figs.

Mokrzecki, S.—Naturgeschichte einer Halmeule (*Tapinostola maculosa,* Hb.). Zeit. f. wiss. Insekten., 1907, Bd. iii, pp. 87-92, 6 fign.

Newell, W.—Notes on the Habits of the Argentine or "New Orleans" Ant, *Iridomyrmex humilis,* Mayr. Journ. Econ. Entom., 1908, vol. i, pp. 21-34.

Ransome, B. H.—Notes on Parasitic Nematodes, including descriptions of new Genera and Species, and observations on life-histories. U.S. Dept. Agric., Bur. of An. Indus., Circ. 116, 1907, pp. 1-7.

The new species are *Trichostrongylus capricola, Ostertagia* (n. gen.) *trifurcata, marshalli,* and *occidentalis, Cooperia* (n. gen.) *pectinata,* and *Nematodirus* (n. gen.), the *Strongylus fillicollis* of Rudolphi being the type.

Schreiner, J. T.—Zwei neue interessante Parasiten der Apfelmade *Carpocapsa pomonella,* L. Zeit. f. wiss. Insekten, 1907, Bd. iii, pp. 217-220, 1 fig.

Scott, Hugh.—On a large series of *Nycteribiidae,* parasitic Diptera, from Ceylon. Trans. Entom. Soc. Lond., 1907, pp. 421-428.

Silvestri, F.—Descrizione di un novo genere d'insetti apterigoti rappresentante di un novo ordine. Boll. Lab. Zool., R. Scuola Sup. d'Agric. Portici, 1907, vol. i, pp. 286-311, 18 text figs.

Silvestri, F.—Descrizione e prime notizie biologische dell' Ecofillembio dell' Olivio (*Oecophyllembius neglectus,* Silv.). Ibid., 1908, vol. ii, pp. 195-216, 23 text figs.

Smith, J. B.—Cultivation and Susceptibility to Insect Attack. Journ. Econ. Entom., 1908, vol. i, pp. 15-17.

Williamson, E. B.—The Dragonflies (Odonata) of Burma and Lower Siam—II. Sub-families *Cordulegasterinae, Chlorogomphinae,* and *Gomphinae.* Proc. U.S. Nat. Mus., 1907, vol. xxii, pp. 267-317, 39 text figs.

IV.—Agriculture and Horticulture.

Bedford, The Duke of, and Pickering, S. U.—Eighth Report of the Woburn Experimental Fruit Farm. Pp. iv + 129 and three appendices. London: The Amalgamated Press, Ltd., 1908. Price 2s. 6d.

The work here detailed is of great interest and value, but it is most unfortunate that the authors should write as if they were the only experimenters with insecticides and fungicides; that they were always right and everyone else always wrong. Indeed one would imagine, did one not know otherwise, that His Grace the Duke of Bedford and Mr. Pickering alone were the only people who were permitted to investigate such matters.

Whilst most of the experiments are interesting, many of the results are scarcely practicable, and a few are practically useless. The "if's" and "buts" are very numerous, and, as we have had occasion to previously remark with reference to earlier Reports, this badly wants editing.

L. G.

Cathcart, C. S.—Analyses of Paris Green. New Jersey Agric. Exp. Stat., Bull. 205, 1907, pp. 1-9.

Chittenden, F. H.—An Injurious North American species of *Apion,* with notes on related forms. U.S. Dept. Agric., Bur. of Entom., Bull. No. 64, pt. iv, 1908, pp. 29-32, fig. 7.

Evans, J. B. P.—Peach Leaf Curl. *Exoascus deformans,* Fckl. Transv. Agric. Journ., 1908, vol. vi, pp. 259, 260, 2 plts.

Hinds, W. E.—Some Factors in the Natural Control of the Mexican Cotton Boll Weevil. U.S. Dept. Agric., Bur. of Entom., Bull. No. 74, 1907, pp. 1-79, plts. i-iv, and 2 figs.

The author discusses the influence of temperature and moisture, cultural conditions, and of heat, ants, and parasites.

Howard, C. W.—The Scale Insects of Citrus Trees. Transv. Agric. Journ., 1908, vol. vi, pp. 265-277, plts. 22, 23, 2 text figs.

Howard, L. O., and Chittenden, F. H.—The Catalpa Sphinx. (*Ceratomia catalpae,* Bdv.). U.S. Dept. Agric., Bur. of Entom., Circ. No. 96, 1907, pp. 1-7, 2 figs.

Howard, L. O., and Chittenden, F. H.—The Bagworm. (*Thyridopteryx ephemeraeformis,* Haw.). U.S. Dept. Agric., Bur. of Entom., Circ. No. 97, 1908, pp. 1-10, 11 figs.

Howell, A. H.—The Relation of Birds to the Cotton Boll Weevil. U.S. Dept. Agric., Biol. Sur., Bull. No. 29, 1907, pp. 1-31, 1 plt., and 6 text figs.

Hunter, W. D., Newell, W., and Pierce, W. D.—The Insect Enemies of the Boll Weevil. State Crop Pest Comms. of Louisiana, Circ. No. 20, 1907, pp. 1-7, 3 figs.

Kellogg, V. L.—The Mallophagan Parasites of the Kea. Psyche, 1907, vol. xiv, pp. 122, 123.

Lantz, D. E.—An Economic Study of Field Mice (Genus *Microtus*). U.S. Dept. Agric., Biol. Surv., Bull. No. 31, pp. 1-64, plts. i-viii, 3 figs.

Lefroy, H. M.—Practical Remedies for Insect Pests. Agric. Journ. India, 1907, vol. ii. pp. 356-363.

Lefroy, H. M.—The Tse-Tse Fly in India. Ibid., pp. 374-376.

Marlatt, C. L.—The White Ant. (*Termes flavipes,* Koll.). U.S. Dept. Agric., Bur. of Entom., Circ. No. 50, rev. ed. 1908, pp. 1-8, 4 figs.

Pierce, W. D.—Studies of Parasites of the Cotton Boll Weevil. U.S. Dept. Agric., Bur. of Entom., Bull. No. 73, 1908, pp. 1-63, plts. i-iii, and 6 figs.

Quaintance, A. L.—The Lesser Apple Worm (*Enarmonia prunivora,* Walsh). U.S. Dept. Agric., Bur. of Entom., Bull. No. 68, pt.v, 1908, pp. 49-60, plt. vii, 1 text fig.

Quayle, H. J.—Insects Injurious to the Vine in California. Calif. Univ. Agric. Exp. Stat., 1907, Bull. No. 192, pp. 99-140, 24 text figs.

Reh, L.—Insektenfrass au Kakao-Bohnen. Zeit. f. wiss. Insekten., 1907, Bd. iii, pp. 21-25.

died of American foul brood. It is clear, therefore, that infectious material in a colony dying of this disease remains even after the comb is destroyed.

Phillips, E. F.—Bee Diseases: A Problem in Economic Entomology. Journ. Econ. Entom., 1908, vol. i, pp. 102-106.

Reynolds, M. H., and Beebe, W. L.—Dissemination of Tuberculosis by the manure of Infected Cattle. Univ. Minn. Agric. Exp. Stat., Vet. Div., Bull. No. 103, 1907, pp. 39-62, 8 figs.

Theiler, A.—The Prevention and Eradication of Stock Diseases in South Africa. Transv. Agric. Journ., 1908, vol. vi, pp. 217-233, 1 plt.

THE

JOURNAL OF ECONOMIC BIOLOGY.

ON A COLLECTION OF COCCIDAE AND OTHER INSECTS AFFECTING SOME CULTIVATED AND WILD PLANTS IN JAVA AND IN TROPICAL WESTERN AFRICA.

By

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With Plates III and IV.

The insects herein described and catalogued were collected by Dr. W. Busse, Regierungsrat, Kaiserliche Biologische Anstalt fur Land-und Forstwirschaft, Berlin.

The material was placed in my hands in January 1906, and the MSS. and drawings practically completed shortly afterwards; but owing to other pressing matters I was compelled, much to my regret, to lay the work aside and I have only just been able to revise and complete it.

I take this opportunity of tendering to Dr. Busse my most sincere apologies for the long and unavoidable delay, and beg that he will accept my sincere thanks for giving me the opportunity of examining this interesting collection of insects.

Fam. Coccidae.

Aspidiotus destructor, Signoret.

Ann. Soc. Ent., Fr. (1869), (4), ix, p. 120.

Habitat.—On the leaves of the Cocoa-Palm (*Cocos nucifera*, Linn.), Lome, Togo, xi, 05 (No. 3675). On *Calophyllum inophyllum;* Atakpome, Togo, x, 01 (No. 3673). On Coco-nut leaves, Kpeme, Togo, i, 05 (No. 3676).

Dr. Busse informs me that this insect causes great harm to the coco-nut plantations in Togo, causing the infested leaves to become yellow and dry.

It is generally a destructive species especially so in the West Indies. It occurs also in China, Formosa, India, Laccadive Islands, Bourbon Island, Mauritius, Demerara, and Mexico, and has also been recorded from other parts of Africa.

Palms of various kinds are its favourite food-plants, but it is a general feeder and among a number of plants I may mention, Mango (*Mangifera indica*), Banana, Nutmeg (*Myristica fragrans*), *Celtis occidentalis, Terminalia catappa,* etc.

Larvae and adults of two species of *Coccinellidae* of the genus *Chilocorus* were associated with the coccid; the one with a red head, black thorax, and red discoidal patch on the elytra is allied to *C. discoidens;* the other with a red head and thorax and red at the base and apex of the elytra is probably undescribed. These beetles and their larvae had destroyed between 80 and 90 per cent. of the coccids, so that their presence must have been extremely beneficial.

Aspidiotus ? sp.

Habitat.—On an unknown shrub; Amussukovhe, Togo, 10.ii.04 (No. 3322).

These examples were so badly infested with a pale orange fungus as to render the coccids quite undeterminable. A similar fungus is known to attack two species of *Diaspinae* in Central Africa.

Aulacaspis cinnamomi, n.sp.

Pl. III, figs. 1-3.

Female puparium approximately circular, low convex or flat, thin and often wrinkled; opaque white with a faint tinge of greenish-yellow giving it a somewhat wax-like appearance, but this character is not always evident; pellicles translucent, dusky ochreous, with a median ridge of black forming a distinct median line.

Length, 1.25-2; greatest width, 1.75-2 mm. Male puparium strongly tricarinate, normal.

Adult female (Pl. III, fig. 1) very elongate with the cephalo-thoracic area nearly as broad as long, posterior angles almost right angles, sides almost straight as far as the large thoracic tubercles. Abdominal segments strongly produced. Pygidium (figs. 2, 3) with one short irregular series of 4 dorsal glands, and an isolated pair in the region of the articulation of the abdomen with the pygidium; circumgenital glands in five groups: median group of about 15, upper laterals 16-19, lower laterals 16-17; median lobes widely divergent tips free, edges and tips serrated; second and third lobes duplex,

outer lateral edges faintly serrated, the lower lobule of the third pair is sometimes divided at the lower margin; the six bilateral squames are simple; the marginal pores are seven in number, the subcutaneous tubes of which become shorter as they approach the first free abdominal segment.

Habitat.—On *Cinnamomum ceylanicum* (seedling plants); Molioardjo, East Java, 7.i.03 (No. 1784). Also on an unknown shrub in the forest near Smeroe (Casuarinen Region); about 1,800 m. (No. 1788).

Aulacaspis javanensis, n.sp.

Pl. III, figs. 4-6.

Female puparium approximately circular, flat or low convex, smooth and wax-like and somewhat opaque; larval exuviae marginal, pale fulvus.

Length, 1.50-2 mm; greatest width, 1.50-2 mm. Male puparium white and strongly tricarinate.

Adult female (fig. 4) very elongate, highly chitinised; cephalothorax nearly as broad as long, posterior angles broadly rounded (in well restored specimens), free abdominal segments broad and strongly produced at the sides. Pygidium (Pl. III, figs. 5, 6) with *three continuous series of dorsal glands*, the second and third series extending into the succeeding segment of the abdomen; circumgenital glands in five almost continuous groups, the anterior group of 15-16, the anterior laterals from 18-22; median lobes widely divergent, apices free, inner margin curved outwards and finely serrated; second and third lobes duplex, small; third pair often obscured by the thickened apex of a projecting marginal pore; squames 7-8 in number, simple, and there are 4-5 on the adjacent segment; marginal pores 8-9, a few small ones also occur on the rudimentary and two succeeding segments of the abdomen.

Habitat.—On Ericacea (?) and two undermentioned shrubs. Forest on the mount Smeroe, East Java, about 1800 m., 7.i.03 (Nos. 1785, 1786), also on an aquifoliaceous shrub. Forest on the Smeroe, 7.i.03 (No. 1789) and in Bamboo-wood on the Smeroe, 14-1500 m., 7.1.03 (No. 1790).

Fiorinia diaspiformis, n.sp.

Pl. III, figs. 7-10.

Female puparium purple brown or smoky brown, margins paler; *secretional margin unusually wide*, often considerably wider than the

length of the nymphal pellicle; pellicles pale yellowish-brown, terminal secretionary covering smoky brown. Form somewhat irregular, usually broadly pyriform, but some examples have a tendency to become more or less circular.[1] Ventral pellicle complete, thin anteriorly, thick posteriorly; colour smoky grey.

Length, 1.75-2.75 mm., width, 1.50-2 mm.

Male puparium white, thickly felted and very strongly tricarinate; pellicle yellowish-brown.

Length, 1 mm.

Adult female oviparous; not highly chitinised; ovate, with the margins of that free abdominal segments strongly defined; cephalo-thoracic area distinctly divided. Rostral filaments[2] two and a half to three times the length of the body.

Rudimentary antennae placed closely together near the anterior margin, each furnished with a single, long curved spine. Para-stigmatic glands arranged in a compact group, anteriorly. Anal orifice immediately below the anterior group of circumgential glands. Pygidium (Pl. III, figs. 7, 8) somewhat produced; median lobes small approximate, margins strongly dentate; lateral lobes small, entire, the first sometimes spatulate; synames large, four on either side, and there are three or four on each of the succeeding abdominal segments; spines minute; the first three or four pairs of marginal pores with more or less angular projections, the rest not so, and they extend into the cephalo-thoracic area. Circumgenital glands in five groups; median with 10-11; upper laterals with 22-28; lower laterals with 16-27. Dorsal pores in three continuous series, the third following the line of the succeeding segment.

Second Stage Female (Pl. III, fig. 9) much more elongate than the adult female. Margin of pygidium (Pl. III, fig. 8) closely resembling that of the adult, but the lateral lobes are either quite rudimentary or entirely absent, and there are only four bilateral marginal pores, forming angular or rounded projections.

The female puparium superficially resembles certain forms of *Aulacaspis* due to the abnormally large supplementary secretion. The other distinguishing feature is the enormously long rostral filaments.

Habitat.—On *Piper* sp.; Bamboo-wood on the Smeroe, East Java, about 1,500 mm., 7.i.03 (No. 1787).

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[1] These forms are apparently immature.

[2] These organs become detached almost invariably in the process of removal from the food-plants.

Chionaspis (Hemichionaspis) aspidistrae

var. **gossypii**, n. var.

Female puparium. Form resembling typical examples of *C. aspidistrae*, being elongate and widened posteriorly but with little tendency to become curved or mytiliform. Colour pale ochreous; texture rough owing to a scanty, superimposed, layer of red-brown bark fibres being incorporated with the secretionary matter; pellicles darker than the rest of the puparium.

Length, 2-2.50 mm.

The adult females are slightly larger than typical examples found under glass in Europe; but structurally they are practically identical.

The examples submitted for examination almost covered the bark of the small branches, and must therefore have caused some injury to the plant.

Habitat.—On *Gossypium hirsutum*; Kpeme, Togo, i.05 (No. 3678).

Mytilaspis (Lepidosaphes) ? sp.

Habitat.—On *Terminalia catappa*, Buitenzorg, Java; xii.02 (No. 1701).

Three female puparia in association with *Parlatoria proteus* and a species of *Aleurodes*. The material was not sufficient for diagnostic purposes.

Parlatoria proteus, Curtis.

Gardener's Chronicle (1843), p. 676.

Habitat.—On *Terminalia catappa*; Buitenzorg, Java; xii.02 (No. 1701). This species was found in association with *Aleurodes* sp. and *Mytilaspis* sp. Not hitherto recorded from Java; but this insect is very widely distributed throughout the world.

Dactylopius coffeae, n.sp.

Pl. III, figs. 14-16.

Adult female covered with densely felted plates of white secretion, but this covering was so much injured as to render it impossible to give a correct description of its arrangement. Form rather short, ovate. Antenna (Pl. III, figs. 14, 14a.) long, setose, of eight segments, terminal segment much the longest and some of the hairs upon it are longer and stouter than the rest. Legs normal. Margins with an equidistant series of spines (Pl. III, fig. 9) usually in pairs, each surrounded by a group of rather large spinnerets. Dermal spinnerets minute; spines few and scattered. There are two pairs of large

ventral glands (Pl. III, 16), the first pair are placed near the margin immediately below the insertion of the antennae, the other pair also submarginal, are situated a little anterior to the anal opening; each gland has a long transverse slit and a bilateral lunular patch of chitine thickly studded with spinnerets and minute hairs. Anal orifice with six hairs. Anal lobes normal, each with a few short spine-like hairs and a single long stout hair.

Habitat.—On Liberian coffee; Java, 7.i.03 (No. 1791).

This species may be distinguished chiefly by the densely felted plates of white secretion which cover the dorsum.

In the form of the waxy covering it resembles *D. nipae,* but it is a much larger insect.

Ceroplastes theobromae, n.sp.

Test of adult female reddish pink, darker in old examples, nucleated; margin with two large bilateral, stout, white appendages; caudal process uncovered at the tip; posterior extremity with two large mammiform swellings.

Length, 4-5; width, 3.50-4.75 mm.

Adult female. Dermis smooth, shining, highly chitinised; cephalic area clypeate; caudal process short. Antennae of six segments of which the third is slightly longer than all the succeeding segments together; fourth and fifth shortest and together equalling the length of the seventh. The three terminal segments are deeply constricted and so also is the third near the distal extremity. Stigmatic clefts deeply emarginate; spines obconical and short.

Habitat.—On Cocao; Soppo, Cameroon, 3.iii.05 (No. 3661a); Bamba, Cameroon, ii, 05 (No. 3661).

Lecanium hesperidum var. **javanensis,** n.var.

Pl. III, figs. 11-13.

Adult female elongate or sub-pyriform, dorsum with a distinct longitudinal keel or ridge; abdominal area with a series of irregular rugose carinae. Colour dusky brown, margins paler. Antenna (Pl. III, figs. 11, 11*a*) of seven segments. Marginal spines (Pl. III, fig. 12) minute, curved and finely divided at the tips.

Habitat.—On Liberian coffee; Molio-ardjo, East Jarva, 7.i.3 (No. 1791).

This insect occurred in association with *Dactylopius coffeae.* It differs from typical *hesperidum* by the much smaller marginal spines and the sculpture of the dorsum.

All the specimens were attacked by a fungus on the venter from which it spread outwards, forming a regular and complete fringe all round the margin of the insect. So conspicuous was this fringe that I at first mistook it for a natural fringe of the insect, but on closer examination each filament composing the fringe was found to consist of a mass of delicate mycelia. There was no trace of the fungus in the body cavity but the whole of the ventor was covered by a thick layer of mycelial threads, which had, in all probability, destroyed the insects.

Habitat.— On Liberian coffee; Molio-ardjo, East Java, 7.i.03 (No. 1791).

Hemilecanium, n.g.

Pl. IV, figs. 1-11.

Adult female with the posterior extremity *not cleft*. Anal orifice placed near the middle of the dorsum and closed above with a pair of hinged plates as in Lecanium. Larva and nymph with a distinct anal cleft as in Lecanium. Female in all stages with four large dorsal groups of compound spinnerets.

Hemilecanium theobromae, n.sp.

Adult female (Pl. IV, fig. 1) broadly ovate or sub-circular; margins broadly flat, central area suddenly elevated, with strong irregular prominences. The whole of the dorsal area covered with a thin but dense layer of ochreous meal-like wax, but the prominences of the dorsum are generally denuded, apparently through abrasion, appearing through the secretion as shining, piceous, irregularities. Cuticle shining dark piceous on the central elevated area; dark castaneous and strongly rugose at the margins. Venter covered with a rather thick layer of white fibrous secretion. Anal cleft obsolete, but there is usually a faint emargination at the posterior extremity. Anal orifice placed just within the broad elevated dorsal zone at about one-third of the distance from the posterior margin. Derm cells of two distinct types; those of the dark central area (Pl. IV, fig. 5) narrowly elongate with an apical pore, those of the pale broad margin of the ordinary polygonal type (Pl. IV, fig. 6). There are also four groups of spinnerets: two towards the anterior and two towards the posterior extremity, each group composed of several hundred spinnerets forming well defined dark chitinised areas. Antenna (Pl. IV, fig. 2) of the nine segments, of which the third is the longest; there are a few long hairs on the four terminal segments; formula 3, 4 (5, 2, 9) 6, 1 (7, 8) Legs (Pl. IV, fig. 3) highly

chitinised; slender but small compared with the size of the insect; *coxa almost equalling the length of the femur;* digitules simple. Marginal spines (Pl. IV, fig 4) with their broad bases suddenly contracted each fitting into a well-defined socket, the latter being attached to a short subcutaneous tube. Stigmatic channels and spines absent.

Length, 13-15 mm.; width, 12-13 mm.

Second Stage Female (Pl. IV, fig. 7) broadly ovate, slightly narrowed posteriorly, marginal spines continuous resembling those in the adult. Antennae of seven segments, the third being the longest, the rest of the segments subequal in length. Legs scarcely longer than the antennae; coxa rather broad. Mentum uniarticulate. Groups of spinnerets (Pl. IV, fig. 8) occupying relatively the same position as in the adult, but there are only about 60-70 individual spinnerets in each group; they are also larger and more distinctly separated than in the adult. Derm in the region of the anal cleft finely squamose, with a large subcutaneous tube (Pl. IV, fig. 9); there is also a similar tube just within the margin opposite the anterior stigmata.

Larva (Pl. IV, fig. 10) elongate; position of the compound spinnerets as in the adult and nymph. Mentum monomerous. Antenna (Pl. IV, fig. 11) of six joints, the third equalling the length of the fourth, fifth and sixth together. Marginal spines forming a continuous series.

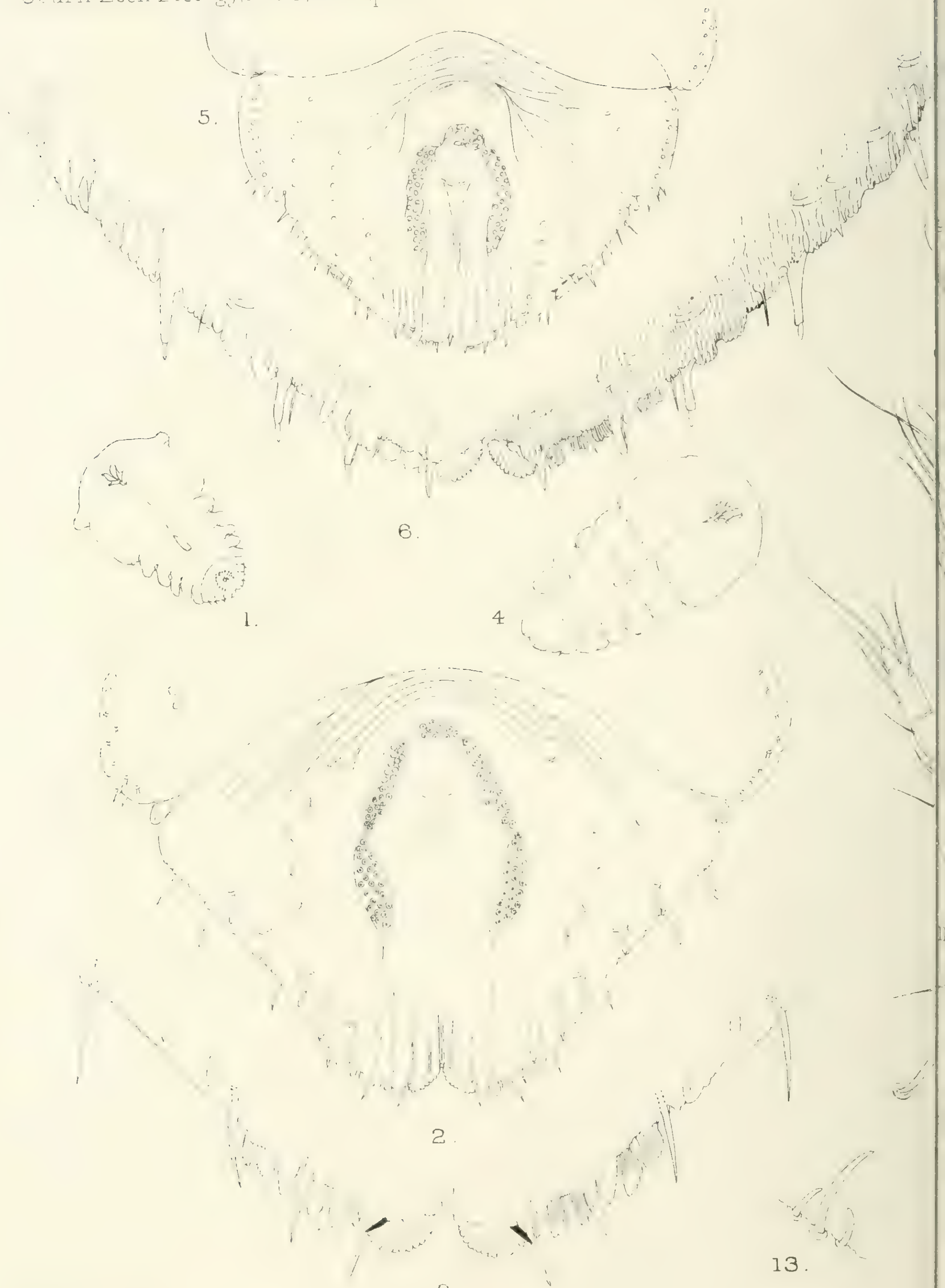
Habitat.—On the stems of the Cacao *(Theobroma cacao);* Soppo, Cameroon, W. Africa, March, 1905 (No. 3677).

This is an extremely interesting and highly protective species, and is also one of the largest members of the *Lecaniinae;* but although so large it is a very inconspicuous insect as the irregular prominences of the dorsum, together with its mealy covering so exactly harmonises with the colour of the bark on which it rests that it is difficult, in many instances, to see where the insect ends and where the bark begins. If I translate Dr. Busse's notes correctly he says "this insect imitates little bosses or excrescences on the bark of the cocoa stems, and so deceptively in shape and colouring that it requires some experience before you can recognise the animals as such."

Stictococcus sjöstedti, Cockerell.

Canadian Ent. (1903), xxxv, p. 64.

Habitat.—On the fruit and fruit-stalks of the Cacao; Victoria, Cameroon; ix.04. (Nos. 3169, 3189).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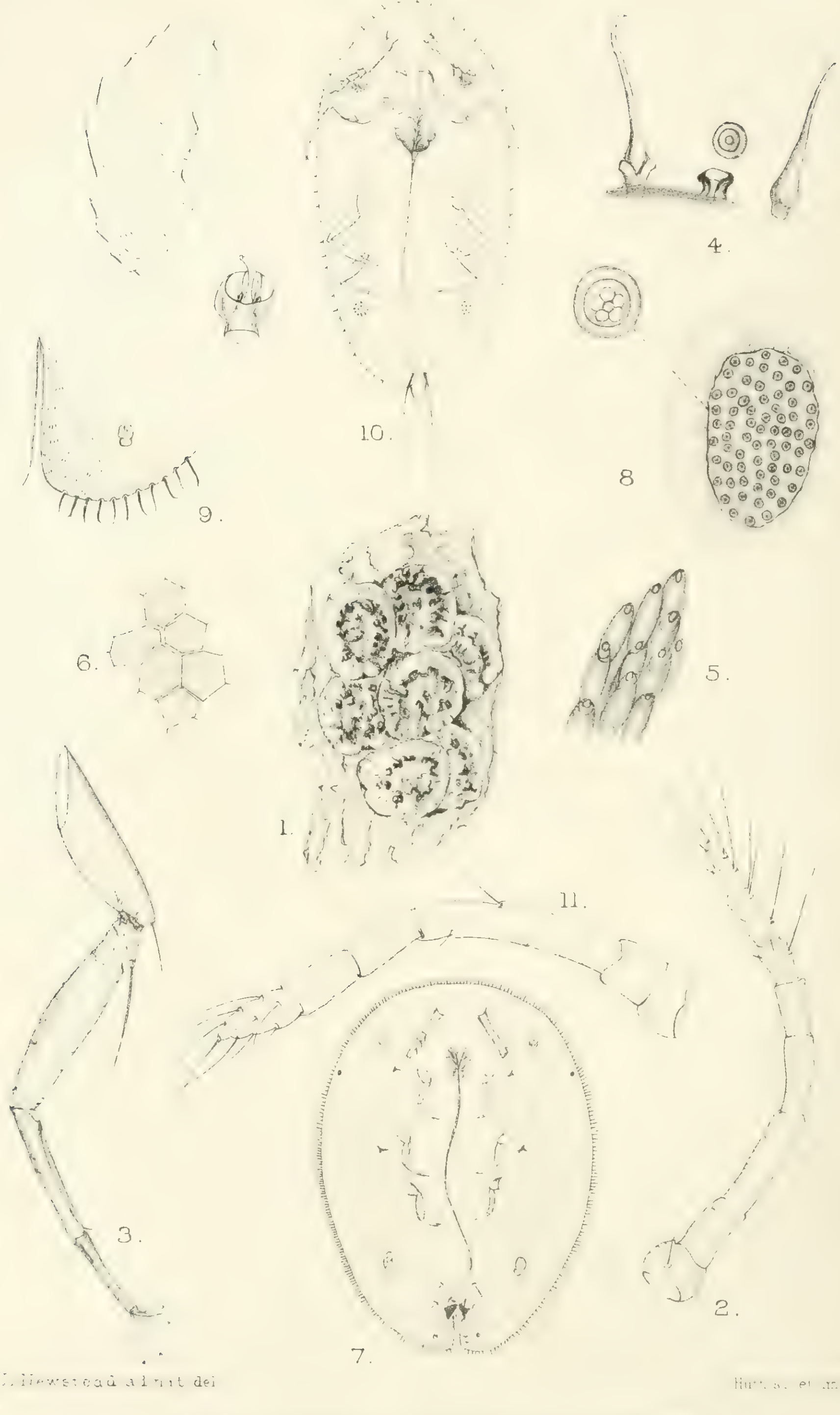

R. Newstead ad nat. del

Huth, Lith. et imp.

HEMILECANIUM THEOBROMÆ n.g. & n.sp.

Since its discovery by Dr. Sjöstedt in 1903, this insect has been found in several other localities along the West Coast of Africa; but it has not been recorded from any other part of the world. From information recently obtained one gathers that this insect is one of the recognised cocoa pests in Western Africa.

Fam. ALEURODIDAE.

Aleurodes ? sp.

Habitat.—Java on *Terminalia catappa;* Buitenzorg, Java, (No. 1701). Associated with *Parlatoria proteus* and the *Mytilaspis.* The leaves were almost covered with this insect, but they were not sufficiently well preserved to enable one to determine them specifically.

Fam. PSYLLIDAE.

Psylla, sp.

Habitat.—On *Kickxia elastica;* Soppo, Cameroon (No. 3674).

This insect produces a deep ovate depression on the underside of the leaf with a corresponding raised, tubercular, swelling on the upper surface. They were packed so closely together that the leaves, from the innumerable pits and swellings, presented a most remarkable appearance.

The examples (No. 3674) sent in the first instance consisted of larvae and pupae, and as it was not possible to determine the insect from the material, Dr. Busse very kindly obtained a further supply of the infested leaves. On examining these I was disappointed to find that the few winged forms which were present were all so damaged as to render them quite useless. This insect is of considerable economic importance, so that further endeavours should be made to obtain perfect examples of the adult.

EXPLANATION OF PLATES III AND IV.

Illustrating Mr. Robert Newstead's paper on "A Collection of *Coccidae* and other Insects affecting some cultivated and old plants in Java and in tropical Western Africa."

PLATE III.

Aulacaspis cinnamomi, n.sp.

Fig. 1.—Adult female (enlarged).
Fig. 2.—Pygidium of do. × 250.
Fig. 3.—Margin of pygidium. × 600.

Aulacaspis jarvanensis, n.sp.

Fig. 4.—Adult female (enlarged).
Fig. 5.—Pygidium of adult female. × 250.
Fig. 6.—Margin of pygidium. × 600.

Fiorinia diaspiformis, n.sp.

Fig. 7.—Pygidium of adult female. × 250.
Fig. 8.—Margin of pygidium of adult female. × 600.
Fig. 9. Margin of pygidium of second stage female. × 600.
Fig. 10. Adult lying within the moulted skin of the second stage female (enlarged).

Lecanium hesperidum var. **jarvanensis**, n. var.

Fig. 11, 11*a*. Antennae of adult female. × 250.
Fig. 12. Marginal spines of adult female. × 600.
Fig. 13. Stigmatic spines of adult female. × 250.

Dactylopius coffeae, n.sp.

Fig. 14, 14a.—Antennae of adult female. × 250.
Fig. 15.—Portion of epidermis (with glands and spines) of adult female. × 600.
Fig. 16.—One of the large glandular orifices of adult female. × 120.

PLATE IV.

Hemilecanium theobromae, n.sp.

Fig. 1.—Group of adult females (natural size).
Fig. 2.—Antennae of adult female (enlarged).
Fig. 3.—Leg of adult female (enlarged).
Fig. 4.—Marginal spines of adult female. × 250.
Fig. 5.—Derm cells of the dark central area of dorsum. × 350.
Fig. 6.—Derm cells of the marginal area. × 250.
Fig. 7.—Second stage female (enlarged).
Fig. 8.—Group of compound spinnerets. × 130, about.
Fig. 9.—Right portion of the anal extremity of the nymph showing the squamose character of the dermis, and the curious secretionary gland (× 600).
Fig. 10.—Larva (enlarged).
Fig. 11.—Antennae of the larva. × 250.

ON AN ENCHYTRAEID WORM INJURIOUS TO THE SEEDLINGS OF THE LARCH.*

By

C. GORDON HEWITT, M.Sc.,

Lecturer on Economic Zoology in the University of Manchester.

WITH PLATE V.

WHEN the seedlings of the larch attain the age of about 12-14 months they are frequently attacked by a small white worm, and the presence of such a pest in a nursery is readily discernable by the dead and withered appearance of the plants.

I find on inquiry that the killing off of the seedlings is attributed by foresters and nurserymen to the presence of "a worm," but the character of the worm when it is specified is usually incorrect, some calling it a "wire-worm" and others an "eel-worm." Last year I was able to examine some larch-seedlings in nurseries at Thirlmere (Cumberland) and found that the worm which was responsible for the damage was neither a wire-worm nor an eel-worm, but differed from each of these by as much as they differ from each other. It proved to be a small white Oligochaet worm, belonging to the family *Enchytraeidae*, and Mr. F. E. Beddard very kindly identified it for me as *Fridericia bisetosa*, Levinsen.

The *Enchytraeidae* form a compact and easily separable family of the Oligochaet worms, which is of course of economic interest on account of the phytophagous habits of some of its members. They not only feed on decaying vegetable matter, but also on living plants, in which cases, as in the present, they sometimes become seriously injurious.

Theobald (1906) records specimens of *Enchytraeia* worms being sent as eel-worms from Hastings, where they occurred in such substances as rotten leaves and road-scrapings, and also in old horse-dung; they were also found in flower beds containing roses and pansies.

The *Enchytraeidae* are small worms ranging, according to Beddard (1895) from 3 mm. to 40 mm. in length. All possess a prostomium.

* Read before the Association of Economic Biologists, Edinburgh Meeting, July 28th, 1908.

The members of the germs *Fridericia*, to which this worm belongs, are chiefly characterised by the possession of dorsal pores: they are also distinguishable in the characters of their setae. Beddard *(t.c.)* states that they are developed in each bundle two at a time, the newly-formed pair lying between the older pair, and the next pair between these, and so on, so that in a group of setae the outermost are the oldest and the innermost are the youngest setae. In this species *F. bisetosa* the older pair usually falls out before the younger ones are formed, so that, as the name implies, the worm has only two setae in each bundle. This, however, is not always the case in *F. bisetosa*, and my observations confirm those of Ude, who found that in immature individuals four setae occur in each group, the older outer pair not having fallen out; I find this to be the case in mature specimens also, and a group of these setae are shown in fig. 3.

Fridericia bisetosa, Levinsen, is defined by Beddard as follows:—

"Length, 20 mm.; number of segments, 60; setae paired; Anteseptal region of nephridium nearly equal to post-septal, with undulating duct. Spermathecae with two diverticula."

The worms are white and at first sight have an appearance rather similar to Nematodes, but on a closer examination their real nature is soon perceived. This species is further characterised anatomically by the fact that the brain is about twice as long as broad, and its posterior border is either straight or slightly concave. The dorsal vessel arises in the 18th segment. The vasa deferentia are long and coiled, and their funnels are twice as long as broad; the spermiducal glands are well developed.

This pest does not appear to attack larches that are more than twelve or fourteen months old. The signs of the attack are a gradual shrivelling up of the whorls of young green leaves, which is followed by a withering of the upper portion of the young seedling as it is gradually killed. If such seedlings are pulled up or, better, carefully dug up, the small white worms, measuring about three-quarters of an inch in length, will be found round the main root and in the earth surrounding it. The injury is done to the root beneath the ground: the cortical tissue is destroyed, as shown in the figure, leaving the central woody cylinder exposed. This radical decortication is fatal to the young plants and they soon die.

Worms of this nature, as Theobald *(l.c.)* has also shown, can be destroyed by means of carbon-bisulphide. On the appearance of this worm in the larch nurseries the method of treating the seedlings which I should suggest would be to inject the carbon-bisulphide by

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FRIDERCIA BISETOSA,

means of a Vermorel or other suitable injector. The injections should alternate on the two sides of each row of seedlings, each injection being about six or eight inches from the row, and stoping obliquely towards the row. So that the volatilising carbon-bisulphide may rise to the roots. The injection must be made deep enough to prevent the liquid touching the roots of the seedlings, and the injections of each side of the row should be about two feet apart. The carbon-bisulphide should only be injected when the soil is dry, otherwise it will not be able to reach the worms at the roots of the seedlings when it volatilises. From a quarter of an ounce to half an ounce, or nine to eighteen grammes, will be sufficient for each injection.

REFERENCES.

1895. **Beddard, F. E.**—" A Monograph of the Order Oligochaeta." 769 pp. *(Oxford, Clarendon Press.)*

1906. **Theobald, F. V.**—" Report on Economic Zoology for the year ending April 1st, 1906." *Journal of the South-Eastern Agricultural College, Wye, Kent.* pp. 29-140.

EXPLANATION OF PLATE V.

Illustrating Mr. C. Gordon Hewitt's paper "On an Enchytraeid Worm injurious to the Seedlings of the Larch."

Fig. 1.—Larch seedling, twelve months old, showing the appearance of the root and shoot of a seedling killed by *F. bisetosa.*

Fig. 2.—*Fridericia bisetosa*, Levinsen.

Fig. 3.—Single Group of setae of *F. bisetosa*, showing the outer and older setae remaining after the appearance of the inner younger setae.

A NOTE ON THE FLIGHT OF THE EARWIG, FORFICULA AURICULARIA, LINN.

By

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Berkhamsted.

The wings of earwigs have long been a subject of interest amongst zoologists, both on account of their actual structure, and also the complex manner in which they fold them up when in repose.

Almost every writer on the *Forficulidae* has drawn attention to the fact that a large number of species of the family have the wings undeveloped, or they are folded in a complex manner, similar to the species under consideration.

In spite of the complexity of the wings in the common earwig, it is generally supposed that they are seldom used. Dr. Sharp[1] writes: "It is quite a mystery why earwigs should fold their wings in this complex manner, and it is still more remarkable that the Insects very rarely use them. Indeed, though *Forficula auricularia* is scarcely surpassed in numbers by any British Insect, yet it is rarely seen on the wing; it is probable that the majority of the individuals of this species may never make use of their organs of flight or go through the complex process of unfolding and folding them."

During the latter part of June and early in July I heard numerous complaints of the enormous number of these insects, which were committing serious damage to garden plants and invading houses in large numbers.

Quite unaware of the rarity of the occasion, a friend remarked to me that they had frequently flown through the open window in an evening, and when I remarked that they were seldom known to fly, he advised me to throw open my window between 9 and 10 p.m.

For three consecutive evenings I opened two casement windows between 9.30 and 10.30, with the following result:—On the first evening eight earwigs entered the room in flight, on the second evening eleven, and on the third evening seven.

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[1] Insects, Camb. Nat. Hist., 1901, vol. i, p. 207.

In nearly all cases they came through the window and flew to the right or left of the room, evidently to avoid the gas, but on two occasions they passed over the gas and settled on the picture moulding opposite to the window.

An examination of the 26 specimens revealed the significant fact that they were all males.

If within the space of one hour an average of 9 insects flew into my room, it seems only reasonable to suppose that there were many more on the wing out of doors.

I am aware that they have previously been recorded in flight,[1] but I think there must be certain conditions that are conducive to this habit.

The three evenings I mention were very warm, calm, sultry ones, and fairly dark. In any case the phenomenon is sufficiently rare to be worthy of placing on record.

Since the above was written a case has come under my observation of where in the open daylight a specimen flew in at the window of an office, settled on an open book, and the process of folding the wings was carefully noted by the observer; also a further case where one was knocked off a person's coat, and instead of falling to the ground immediately took to flight.

[1] See Theobald, Entom. Mon. Mag., 1896, vol. vii (2nd Ser.), p. 60.

REVIEWS AND CURRENT LITERATURE.

I.—General Subject.

Burgess, A. F.—Uniform Common Names for Insects. Journ. Econ. Entom., 1908, vol. i, pp. 209-213.

A very useful list, but we do wish that American Economic Entomologists would not use the term "worm" for larva or caterpillar.

De Vries, Hugo.—Plant Breeding. Comments on the Experiments of Nilsson & Burbank. Pp. xv + 360, 114 figs. London: Kegan Paul, Trench, Trübner & Co., Ltd 1907. Price 7s. 6d.

In the author's words the main aim of these Essays is to give proof of the assertion that "Hybridization is the scientific and arbitrary combination of definite characters. It does not produce new unit-characters; it is only the combination of such that are new. This far-reaching agreement between science and practice is to become a basis for further development of practical breeding as well as of the doctrine of evolution."

The appreciation of such investigations as are here set forth must soon change the whole aspect of agricultural plant breeding, and consequently such a work as that before us is full of interest to the practical breeder as well as the student of plant evolution.

All who have studied the work of De Vries know how such has materially modified our views as to the origin, selection and adaptation of species, and these facts are in these essays brought home to one with a force that compels recognition.

After a brief introductory chapter on Evolution and Mutation, the author discusses in detail the work of Hjalmar Nilsson and that of Luther Burbank, sandwiching in between these a most lucid and fascinating chapter on Corn Breeding. In the two concluding chapters the association of characters in plant-breeding is fully discussed, and more briefly, the geographical distribution of plants.

Corn breeding, we are informed, is a new industry, hardly older than ten years, but it has developed at once on a commercial scale. Experience

proves it to be highly profitable, and the conviction is rapidly spreading that no corn grower can afford to be ignorant of its principles and its results.

We heartily commend the book to all who take an intelligent interest in plant breeding.

W. E. C.

Forel, Auguste.—The Senses of Insects. Translated by Macleod Yearsley. Pp. xv + 324, plts. 1, 2. London: Methuen and Co., 1908. Price, 10s. 6d.

Biologists, and entomologists in particular, are under a debt of gratitude to Mr. Macleod Yearsley for the English translation of Dr. Forel's fascinating work. As he justly remarks the work is but little known in this country, is full of interesting experimental details, and exhibits such a wide field of painstaking investigation that it only requires translation to find a considerable number of readers in this country.

So much that is worthless has been written upon the senses of insects, or perhaps we should say the supposed senses, that one turns to the present work with a feeling of relief and with a knowledge that the subject is being dealt with by a masterly mind and in a logical, fair, and open-minded manner.

It is not our intention to attempt any detailed criticism, but we cannot refrain from stating that a careful perusal of this book has only whetted our appetite for more such observations, and at the same time afforded a pleasure not realized since we read Semper's "Animal Life" and Lubbock's "Senses, Instincts, etc., of Animals."

It is a book to read and think over, and to all who have the slightest interest in the ways of insects our advice is "get it at once."

W. E. C.

Gamble, F. W.—Animal Life. Pp. xviii + 305 and 62 figs. London: Smith, Elder and Co., 1908. Price 6s. net.

There has recently been published quite a number of delightfully written works on animal life, unfortunately, however, the value of many of these is considerably mitigated by the many misstatements of fact, inaccurate observation and careless compilation. Dr. Gamble's book differs from such works in that it is most carefully compiled, full references being given to authorities, and free from the other blemishes just referred to.

Throughout the three hundred pages there is exhibited a freshness and lucidity of expression that cannot fail to impress the reader and excite his interest.

It is a book that all interested in animal life may read with pleasure and

profit, and it might with advantage find a place in every college and school library.

The weakest point of the work, if it has one, is the illustrations, which are unworthy of the text.

W. E. C.

Hinds, W. E. and Bishopp, F. C.—A Key suggested for the Classification of Entomological Records. Journ. Econ. Entom., 1908, vol. i, pp. 91-102.

Isaac, J.—Entomology in Outline. 2nd Rpt. Comms. Hort. Calif. for 1905-6, 1907, pp. 35-154, 1 plt. and 111 text figs.

This excellent introduction to entomology has been written in the simplest manner, in plain, everyday language, divested so far as possible of all scientific and technical terms. It is intended for the horticultural commissioners, fruit-growers, and farmers, and is in no sense offered as a scientific dissertation on entomology.

The author has fulfilled a by no means easy task in an admirable manner, which cannot fail to be fully appreciated by those for whom it is intended.

W. E. C.

Knuth, P.—Handbook of Flower Pollination. Translated by J. R. Ainsworth Davis, vol. ii, pp. viii + 703, and 210 text figs. and 1 portrait. Oxford: The Clarendon Press, 1908. Price 32s. 6d. net.

We extend a hearty welcome to the second volume of this most interesting and valuable work. It is a veritable mine of information of interest alike to the botanist and entomologist, while it bristles with points of general biological interest.

The present volume deals with fifty-six natural orders.

The information given is concise but sufficiently full when read in conjunction with vol. i.

The whole subject of flower pollination is one of such immensity and so closely allied to other equally fascinating biological phenomena, that we dare not attempt any lengthy review, even did space permit or were we capable of such, for a work of this character speaks for itself, and must find a place and a welcome wherever biological problems are studied or taught.

W. E. C.

Massee, G. & Theobald, F. V.—The Enemies of the Rose. Pp. 84, 8 col. plts. and 5 figs. National Rose Society. [1908].

This little handbook is conveniently divided into two parts, viz., one, written by Mr. Massee, treating of the Diseases caused by Fungi, and another on Insect Enemies for which Mr. Theobald is responsible.

In 18 pages Mr. Massee has given a valuable and admirably condensed account of the different fungi attacking the rose, together with the preventive and remedial treatment. The description is well illustrated by four coloured plates showing the appearance of different diseases.

Mr. Theobald's account of the insect enemies of the rose is just as prolix as Mr. Massee's is brief, whilst many of the insects enumerated are scarcely what the rose grower regards as enemies, for the simple reason that he seldom, if ever, is troubled with them.

The remedies suggested are not always the happiest. The writer has more than once ruined beautiful plants by using quassia for greenfly, and has also seen great mischief wrought by the use of arsenate of lead on roses.

Such remedies are behind the times and belong to a day when rule of thumb culture obtained, happily they are now things of the past to the intelligent and up-to-date rose grower.

The "General Account of Insects" might have been omitted with advantage, whilst some reference to the authorities from whom Mr. Theobald has collated his facts would have been valuable.

L. G.

II.—Anatomy, Physiology, and Development.

Effenberger, W.—Die Tracheen bei *Polydesmus*. Zool. Anz., 1897, Bd. xxxi, pp. 782-786, 4 figg.

Enderlein, G.—Über die Segmental-Apotome der Insekten und zur Kenntnis der Morphologie der Japygiden. Ibid., pp. 629-635, 8 figg.

Haller, B.—Über die Ocellen von *Periplaneta orientalis*. Ibid., pp. 255-262, 4 figg.

Hirschler, J.—Über leberartige Mitteldarmdrüsen und ihre embryonale Entwicklung bei *Donacia*. Ibid., pp. 766-770, 4 figg.

Holmgren, N.—Zur Morphologie das Insektenkopfes. Ibid., Bd. xxxii, pp. 73-97. 11 figg.

Imms, A. D.—Notes on the Structure and Behaviour of the Larva of *Anophles maculipennis*, Meigen. Proc. Camb. Phil. Soc., 1907, vol. xiv, pp. 292-295.

Shafer, G. D.—Histology and Development of the Divided Eye of Certain Insects. Proc. Washington Acad. Sci., 1907, vol. viii, pp. 459-486, 4 plts.

Wassilleff, A.—Die Spermatogense von *Blatta germanica*. Arch. mikr. Anat., 1907, Bd. lxx, pp. 1-42, T. i-iii, 1 fig.

Zavrel, J.—Die Augen der Dipterenlarven und-Puppen. Zool. Anz., 1907, Bd. xxxi, pp. 247-255, 13 figg.

Ziegler, H. E.—Die Tracheen bei *Iulus*. Ibid., pp. 776-782, 3 figg.

III.—General and Systematic Biology, and Geographical Distribution.

Banks, N.—A Revision of the Ixodoidea, or Ticks of the United States. U.S. Dept. Agric., Bur. of Entom., Tech. Ser. No. 15, 1908, pp. 1-61, plts. i-x.

A valuable paper to students of the Ixodoidea generally. The author records 38 species and 3 unplaced forms.

Bayer, É.—Notes sur les Galles de *Dryophanta agama* et *disticha* de l' iconographie "Galles de Cynipides." Marcellia, 1908, vol. vii, pp. 3-9, figs. 1-6.

Bezzi, M.—Noterelle cecidologiche. Marcellia, 1908, vol. vii, pp. 10-13.

Brues, C. T.—The Correlation between habits and structural characters among parasitic Hymenoptera. Journ. Econ. Entom., 1908, vol. i, pp. 123-128.

Brunetti, E.—Revision of the Oriental *Stratiomyidae*. Rec. Indian Mus., 1907, vol. i, part 11, pp. 85-132.

A useful paper including tables of genera and species, and also descriptions of several new forms.

Brunetti, E.—Notes on Oriental Diptera. Nos. I and II. Ibid., pp. 163-170,

The first part of these notes comprises a list of the oriental species of the important economic group *Diopsinae*. Altogether 12 specie of *Diopsis*, 9 of *Teleopsis* and 2 *Sphyracephala* are enumerated. Part II. is a preliminary report on a collection of about 130 species of Diptera obtained between April 24th and May 8th, 1907, in the Simla district, at altitudes varying from 5,000 to 8,700 ft. The collection exhibits a marked Palaearctic facies, and considerable proportion of European species, these latter, moreover, retaining for the most part their typical form.

A. D. Imms.

Carnes, E. K.—The *Coccidae* of California. 2nd Rpt. Comms. Hort. Calif. for 1905-6, 1907, pp. 155-222, plts. ii-v, 34 text figs.

A very useful and interesting paper enumerating 132 species.

Caudell, A. N.—Notes on some Western Orthoptera; with the description of one New Species. Proc. U.S. Nat. Mus., 1908, vol. xxxiv, pp. 71-81.

Cépède, C.—Entretiens sur les Sporozoaires parasites des insectes. Feuille jeun. Nat., 1907 (4) Ann. 37, pp. 62-65, 85-90, 19 figs.

Felt, E. P.—Observations on the genius *Contarinia*. Journ. Econ. Entom., 1908, vol. i, pp. 225-227.

Fletcher, T. B.—On the Larva of *Prodenia synstictis*. Spolia Zeylanica, 1908, vol. v, pp. 95-97.

Franklin, H. J.—On a collection of Thysanopterous Insects from Barbadoes and St. Vincent Islands. Proc. U.S. Nat. Mus., 1908, vol. xxxiii, pp. 715-730, plts. lxiii-lxv.

Gillette, C. P.—*Aphis gossypii*, Glov., and its Allies. Jour. Econ. Entom., 1908, vol. i, pp. 176-181.

Headlee, T. J.—Life History of the Striped Cucumber Beetle, with a brief account of some experiments for its control. Journ. Econ. Entom., 1908, vol. i, pp. 203-209.

Houghton, C. O.—Notes on *Trogoderma tarsale*, Marsh. Journ. Econ. Entom., 1908, vol. 1, pp. 216-217.

Jordan, K. and Rothschild, N. C.—Revision of the Non-combed eyed Siphonaptera. Parasitology, 1908, vol. i, pp. 1-100, plts. i-vii.

Marlatt, C. L.—The National Collection of *Coccidae*. U.S. Dept. Agric., Bur. of Entom., Tech. Ser. No. 16, Pt. 1., 1908, pp. 1-10.

Martelli, G.—Note dietologiche sulla mosca delle olive. Boll. Lab. Zool. gen. e agrar. Portici, 1908, vol. ii, pp. 1-12.

Martelli, G.—Osservazioni sulle Cocciniglie dell' olivo fatte in Puglia e in Calabria. Ibid., pp. 217-296, 22 figs.

Masi, L.—Sul numero e sulla denominazione dei parassiti della mosca delle olive. Ibid., pp. 185-194, 1 fig.

Niessen, J.—*Aphis cardui*, L. auf *Oenothera muricata*, L. Marcellia, 1908, vol. vii, p. 14, 2 figs.

Paiva, C. A.—Records of Hemiptera and Hymenoptera from the Himalayas. Rec. Indian Mus., 1907, vol. i, part i, pp. 13-20.

Comprises a number of species collected during 1905 and 1906 by four or five collectors in various parts of the Himalayas. Exact localities and

approximate altitudes are given, and the list is of importance to students of distribution, dealing as it does with localities up to 11,000 ft.

Pierce, W. D.—Descriptions of new Curculionid Beetles of the Tribe *Anthonomini*. Proc. U.S. Nat. Mus., 1908, vol. xxxiv, pp. 173-181.

Quayle, H. J.—The California Life History of the Grape Leaf-Hopper, *Typhlocyba comes*, Say. Ibid., pp. 182-183, plts., i, ii.

Rübsaamen, E. H.—Beiträge zur Kenntnis Aussereuropäischer Zoocecidien. Marcellia, 1908, vol. vii, pp. 15-79, figs. 8-17.

Schaus, W.—Descriptions of Three Species of Saturman Moths. Proc. U.S. Nat. Mus., 1908, vol. xxxiv, pp. 65-66.

Shelford, R.—*Aenigmatistes africanus*, a new Genus and Species of Diptera. Journ. Linn. Soc. Lond., 1908, Zool. vol. xxx, pp. 150-155, plt. 22.

Shelford, V. E.—Life-Histories and Larval Habits of Tiger Beetles (*Cicindelidae*). Ibid., pp. 157-184, plts. 23-26.

Silvestri, F.—Notizie e considerazioni sugli Imenotteri parassiti della Mosca delle olive in Italia e sulla probabile esistenza di altre specie di essi nel paese ritenuto originario della Mosca stessa. Atti R. Ist d'Incorag. Napoli, 1907 (s. vi), vol. iv, pp. 1-23.

Silvestri, F.—Generazione della mosca delle olive. Boll. Lab. Zool. gen. e agrar. Portici, 1908, vol. ii, pp. 13-17.

Silvestri, F.—La tignola dell' olivo. (*Prays oleellus*, Fabr.). Ibid., pp. 83-184, 68 figs.

Silvestri, F., Martelli, G. e Masi, L.—Sugli Imenotteri parassiti ectofagi della mosca delle olive fino ad ora osservati nel l'Italia meridionale. Ibid., pp. 18-82, 36 figs.

Silvestri, F. e Martelli, G.—La Cocciniglia del fico (*Ceroplastes rusci*, L.). Ibid., pp. 297-358, 37 figs.

Silvestri, F.—Materiali per lo studio dei Tisanuri. Ibid., pp. 359-397, xxiv. figs.

Describes and figures 6 new genera, 11 new species, and 2 new varieties.

Smith, J. B.—Report of the Mosquito Work in 1907. 28th Ann. Rpt., N.J. Agric. Exp. Stat. for 1907, 1908, pp. 479-544, fig. i-xv.

Warren, W.—Descriptions of New Species of South American Geometrid Moths. Proc. U.S. Nat. Mus., 1908, vol. xxxiv, pp. 91-110.

Washburn, F. L.—Egg laying of *Empoasca mali*. Journ. Econ. Entom., 1908, vol. i, pp. 142-145, 2 figs.

IV.—Agriculture and Horticulture.

Alford, F. C.—Extraction of Beeswax. Colorado Agric. Exp. Stat., Bull. 129, 1908, pp. 3-14.

Anon.—The Codling-Moth Parasite. *Caliephialtes messer*, Grav. 2nd Rpt. Comms. Hort. Calif. for 1905-6, 1907, pp. 231-238, plt. ix.

Britton, W. E.—Tests of various gases for fumigating nursery trees to destroy San José Scale. Rpt. Conn. Agric. Exp. Stat. for 1907, 1908, pp. 270-282.

Britton, W. E.—Tests of various gases for Fumigating Nursery Trees. Journ. Econ. Entom., 1908, vol. i, pp. 110-112.

Britton, W. E. and Walden, B. H.—Spraying Tests with commercial "Soluble Oils" to kill the San José Scale. Ibid., pp. 282-285.

Chittenden, F. H.—Insects Injurious to the Loco Weeds. U.S. Dept. Agric., Bur. of Entom., Bull. No. 64, Pt. V, 1908, pp. 33-43, figs. 8-14.

Chittenden, F. H.—The Nut Weevils. U.S. Dept. Agric., Bur. of Entom., Circ. No. 99, 1908, pp. 1-15, 14 figs.

This useful Circular is a reprint from the Yearbook for 1904, and treats of those species infecting chestnuts, pecan nuts, and hazel nuts.

Ehrhorn, E. M.—Insects of the year. 2nd Rpt. Comms. Hort. Calif. for 1905-6, 1907, pp. 223-230.

Fletcher, F.—Note on a Toxic Substance excreted by the Roots of Plants. Mem. Dept. Agric. India, Bot. Ser., 1908, vol. ii, No. 3, pp. 1-16, pl. i.

Forbes, S. A.—Experiments with Repellents against the Corn Root-Aphis. Journ. Econ. Entom., 1908, vol. i, pp. 81-83.

Gillette, C. P.—The Poplar Bark Aphid, *Schizoneura populi*, n.sp. Entom. News, 1908, vol. xix, pp. 1, 2, 1 plt.

Gossard, H. A.—The Catalpa Bud Maggot. Journ. Econ. Entom., 1908, vol. 1, pp. 181-182.

Grossbeck, J. A.—Notes on the Mosquitoes of the Season. 28th Ann. Rpt. N.J. Agric. Exp. Stat. for 1907, 1908, pp. 544-560, 4 plts.

Halsted, B. D.—Report of the Botanist. 28th Ann. Report. N.J. Agric. Exp. Stat. for 1907, 1908, pp. 257-386, plts. i-xxvii.

Herrera, A. L.—The Orange Worm *(Trypeta ludens.)* Journ. Econ. Entom., 1908, vol. i, pp. 169-174.

Jack, R. W.—The Earth Flea [Mite]. Agr. Journ. C. of G. H., 1908, pp. 615-620 4 figs.

Johnson, F.—Grape Root Worm Investigations in 1907. U.S. Dept. Agric., Bur. of Entom., Bull. No. 68, Pt. VI. 1908, pp. 61-68, plts. viii, ix.

Kurosawa, K.—Report on an Experiment in Rearing Silkworms. 2nd Rpt. Comms. Hort. Calif. for 1905-6, 1907, pp. 261-270.

Lefroy, H. Maxwell.—The Rice Bug (*Leptocorisa varicornis*, Fabr.). Mem. Dept. Agric. India, 1908, vol. ii, No. 1, pp. 1-13, plt. i.

Lefroy, H. M.—The Tobacco Stem Borer. Agric. Journ. India, 1908, vol. iii, pp. 65-68, plt. xix.

Lipman, J. G.—Report of the Soil Chemist and Bacteriologist. 28th Ann. Rpt. N. J. Agric. Exp. Stat. for 1907, 1908, pp. 139-204, 3 plts.

Lounsbury, C. P.—The Smyrna Fig and its Pollinating Insect. Agric. Journ. C. of G. H., 1908, pp. 516-568.

McIntosh, W. R.—The Economic Value of Wild Birds. 2nd Rpt. Comms. Hort. Calif. for 1905-6, 1907, pp. 532-540.

Mally, C. W.—The Fruit Fly Paraffin Remedy versus Poisoned Bait. Agric. Journ. C. of G. H., 1908, pp. 609-614.

Newell, W.—The Early Cotton and Boll Weevil. State Crop Pest Comms. Louisiana, Circ., No. 22, 1908, pp. 1-7.

Newell, W. & Paulson, T. C.—The Possibility of reducing Boll Weevil damage by Autumn Spraying of Cotton fields to destroy the foliage and squares. Journ. Econ. Entom., 1908, vol. i. pp. 113-116.

Nobbs, E. A.—Experiments upon the Destruction of Jointed Cactus, 1907. (*Opuntia pusilla*, Haw.). Agric. Journ. C. of G. H., 1908, pp. 341-346.

Paine, C. T.—The Peach Blight. (*Coryneum beyerinkii*). 2nd Rpt. Comms. Hort. Calif. for 1905-6, 1907, pp. 239-247.

Pierce, W. D.—The Economic Bearing of recent studies of the Parasites of Cotton Boll Weevil. Journ. Econ. Entom., 1908, vol. i, pp. 117-122.

Quaintance, A. L.—The Apple-tree Tent Caterpillar. (*Malacosoma americana*, Fabr.). U.S. Dept. Agric., Bur. of Entom., Circ. No. 98, 1908, pp. 1-8, 4 figs.

Quaintance, A. L.—The Apple Maggot or "Railroad Worm." (*Rhagoletis* [*Trypeta*] pomonella, Walsh.). Ibid., Circ. No. 101, 1908, pp. 1-12, 2 figs.

Quaintance, A. L.—Demonstration Spraying for the Codling Moth. Ibid., Bull. No. 68, Pt. VII, 1908, pp. 69-76.

Quayle, H. J.—A new Root Pest of the Vine in California. Journ. Econ. Entom., 1908, vol. i, pp. 175-176.

Sanderson, E. D.—The Gipsy and Brown Tail Moths in New Hampshire. N.H. Agric. Exp. Stat., Bull. 136, 1908, pp. 79-156, 34 figs.

Sanderson, E. D.—Preliminary Report on the Life-history of the Codling Moth and spraying experiments against it. Journ. Econ. Entom., 1908, vol. i, pp. 129-141.

Smith, J. B.—Report of the Entomologist. 28th Ann. Rpt. N. J. Agric. Exp. Stat. for 1907, 1908, pp. 387-478, plts. 1-3, 1 fig.

Street, J. P.—The Chemical Composition of Lead Arsenate and Paris Green. Rpt. Conn. Agric. Exp. Stat. for 1907, 1908, pp. 321-330.

Taylor, E. P.—Life-history notes and control of the Green Peach Aphis, *Myzus persicae*. Journ. Econ. Entom., 1908, vol. i, pp. 83-91.

Waite, M. B.—Progress of Pear Blight Control in California. 2nd Rpt. Comms. Hort. Calif. for 1905-6, 1907, pp. 426-432.

Waite, M. B.—Remarks on Peach Blight. Ibid., pp. 432-436.

Waite, M. B.—Peach Blight. Ibid., p. 513-522, 4 figs.

Washburn, F. L.—The so-called "Green Bug" and other Grain Aphids in Minnesota in 1907. Agric. Exp, Stat. Minnesota, Bull. No. 108, 1908, pp. 257-280, 1 plt. and 15 figs.

Walden, B. H.—The Peach Sawfly (*Pamphilius persicum*, Mac. G.) Rpt. Conn. Agric. Exp. Stat. for 1907, 1908, pp. 285-300, plts. i-vi.

V.—Forestry.

Gillanders, A. T.—Forest Entomology. Pp. xxii + 422 and 351 figs. Edinburgh and London: William Blackwocd & Sons, 1908. Price 15s. net.

We extend a hearty welcome to Mr. Gillanders' new work, which is well printed and very fully illustrated.

The volume opens with an introduction treating of the general structure and classification of insects which might have been amplified with profit. This is followed by a somewhat imperfect account of the Gall-mites (*Eriophyidae*), in which the absence of any reference to Mr. Gussow's and Dr. Nalepa's work on *E. rudis* is to be regretted.

Chapters 2 and 3 deal with the Coleoptera, and in our opinion are the best in the book. The figures are excellent and the descriptions concise, clear, and practical. The next two chapters are allotted to the Hymenoptera, a single one each to Coccidae, Lepidoptera, Aphididae, Diptera, and Psyllidae and Cicadidae.

The concluding chapters treat of collecting and preserving insects; insecticides and general remedies; beneficial insects; and a list of species and their food plants.

We must confess that we read the "Contents" with some surprise. Under the words Forest Entomology the author has included the *Eriophyidae* or Gall-Mites, and whilst classification will always be more or less arbitrary, that chosen by Mr. Gillanders is the strangest.

The omission of the common names of the various insects in not a few cases is a matter for regret, whilst a fuller acquaintance with the literature on Economic Entomology detracts in many cases from the value of the work.

Yet in spite of these minor blemishes the book is sound and certainly the best account of forest insects yet given by any British author, and we congratulate Mr. Gillanders on a piece of work well and ably carried out.

W. E. C.

VI.—Fisheries.

Nelson, J.—Report of the Biologist. Observations on the Fixation of Oyster Spat at Barnegat, N.J., 1907. 28th Ann. Rpt. N.J. Agric. Exp. Stat. for 1907, 1908, pp. 205-256, plts. i-xiii.

Shipley, A. E.—*Echinorhynchus* causing disease in Trout. Field, 1908 (June 27th), p. 1101.

VII.—Medicine.

Bruce David.—The Extinction of Malta Fever. Nature, 1908 (May 14), pp. 39-42, 7 figs.

VIII.—Animal Diseases.

Banks, N.—Tick-borne Diseases and their Origin. Journ. Econ. Entom., 1908, vol. i, pp. 213-215.

Duerden, J. E.—Experiments with Ostriches. V. Scaliness and Unopened Feathers in the Ostrich. Agric. Journ., C. of G.H., 1908, pp. 355-359, 2 figs.

Evans, G. H. & Rennie, T.—Notes on some Parasites in Burma. Journ. Trop. Vet. Sci., 1908, vol. iii, pp. 13-27, plts. iii-xii.

Gough, L. H.—On breeding experiments with *Cysticercus tenuicellus*, Rud., from Sheep, and their development into mature *Taenia marginata*, Batsch, in the South African Jackal. Ann. Transvaal Mus., 1908, vol. i, pp. 62, 63.

Hutcheon, D.—Scab: its Nature, Cause, Symptoms and Treatment. Agric. Journ. C. of G.H., 1908, vol. xxxii, pp. 433-447, 8 figs.

Janin, F.—Researches with the Sarcosporidia of the Sheep. Journ. Trop. Vet. Sci., 1908, vol. iii, pp. 36-70, plt. xiii, and 2 figs.
Translated from the *Archives de Parasitologie*, T. xi, No. 2.

Montgomery, R. E.—On a Spirochaete occurring in the Blood of Chickens in Northern India. Journ. Trop. Vet. Sci, 1908, vol. iii, pp. 1-12, plts. i, ii.

Newell, W. and Mauldin, C. E.—Report upon the Eradication of the Cattle Tick in Lincoln and Claiborne Parishes. State Crop Pest Comms. of Louisiana, Circ. No. 21, 1908, pp. 1-4.

Robertson, W.—A Disease of Fowls simulating in some respects Fowl Cholera. Agric. Journ. C. of G.H., 1908, pp. 577-579, 5 figs.

Warburton, C.—The Ticks infesting Domesticated Animals in India. Imp. Dept. Agric. India, Bull. No. 6, 1907, pp. 1-13, 15 figs.

Fuller, Claude.—Ticks and East Coast Fever. Natal Agric. Journ., 1908, vol. xi, pp. 427-429.

Watkins-Pitchford, H.— Report on the Sheep Disease known as "Blue-tongue." Ibid., pp. 543-549.

Bevan, L. E. W.—A Specific Lung Disease of Calves. Rhodesian Agric. Journ., 1908, vol. v, pp. 399-410.

THE

JOURNAL OF ECONOMIC BIOLOGY.

RATS AND THEIR ANIMAL PARASITES.[1]

By

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THE overwhelming majority of rats fall under two species (i), *Mus rattus*, the black rat, and (ii) *Mus decumanus*, the brown rat. The original home of both species is, according to Dr. Blandford, Mongolia, but the date of their first appearance in our islands is a matter of some uncertainty. According to Helm *M. Rattus* passed into Europe at the time of the *Völkerwanderung*, and doubtless accompanied the migrating Asiatic hordes on their journeys westward. The name rat appears in early High Dutch glossaries; it is mentioned by Albertus Magnus, and occurs in early Anglo-Saxon writings in England. This evidence is, however, not conclusive that in those times the rat had entered Great Britain; indeed, according to Bell,[2] the black rat was not known here until before the middle of the sixteenth century, at least, he says, no author more ancient than that period has described, or even alluded to it as being in Great Britain, Gesner being the first to do so. Jenyns, in his Manual of British Vertebrate Animals,[3] describes *M. rattus* as "truly indigenous," but this is in comparison with the brown rat, whose comparatively recently arrival he chronicles. It is said to have been common on the continent of Europe in the thirteenth century.

Mus rattus has, as a rule, greyish-black fur above, ash-coloured below, with a tail a little longer than the body and head. It is smaller and more elegantly built than the brown rat, its snout is longer and more slender, and the long, thin, scaly tail is about 8 or 9 inches in length. The British forms average in length 7 inches from the tip of

[1] Read before the Association of Economic Biologists, Edinburgh Meeting, July 28th, 1908.

[2] A History of British Quadrupeds. 2nd Ed. London, 1874.

[3] London, 1833.

the nose to the origin of the tail. Although known as the black rat, its bluish, or greyish-black colour is, both in the East and in Northern America, frequently replaced by brown on the upper surface, and by white fur in the lower, or by a yellowish brown rufous colour. The ears, feet, and tail are black. When kept as pets—and they frequently are—white and pie-balded varieties are often bred. The ears are larger in proportion than *M. decumanus*, the rings of scales on the tail better marked, and spines in the fur are not uncommon.

The black rat, or Old English rat, begins to breed under the age of one year, and goes with young six weeks; it breeds frequently during the year, but does not commence in Bombay, according to the Plague Commission, until it has attained the weight of at least 70 grammes. In India they breed all the year round. In Britain they produce six to eleven young at a time; in India the average is 5.2; the largest number found by the Plague Commission having been 9. In Bombay it is noteworthy that in both species the percentage of young rats to the total rat population is greater during the warmer months—from June to October—than at other times of the year. It is also noteworthy that the fall in fertility begins before the onset of the plague Epizootic, though later it roughly coincides with it. In Britain they increase so fast as to overstock their abode, and thus they are forced, from deficiency of food, to devour one another, and this alone, Pennant thinks, "prevents even the human race from becoming a prey to them, not but there are instances of their gnawing the extremities of infants in their sleep."

The black rat is catholic as to its diet, omnivorous, and it devours every kind of human food. It is more domesticated than its congener, more devoted to human habitation, and it does immense damage to stored grain, seeds, and cereals. It is a better climber than *M. decumanus*, which accounts for its being *par excellence* the ship rat, since it can climb hawsers and more readily come on board. It makes its way up to the higher rooms of the tenement houses in Indian cities, where it nests and breeds undisturbed by the human inhabitants. Pennant[1] draws attention to the harm the black rat causes by gnawing and devouring not only edibles, but paper, cloth, water pipes, and even furniture. In England it makes a lodge, either for the day's residence, or a nest for its young, near a chimney, and "improves the warmth by forming in it a magazine of wool, bits of cloth, hay or straw." In the East it nests in the indescribable rubbish and "unconsidered trifles" the natives accumulate in their rooms, and is seldom, if ever, interfered with,

[1] British Zoology, London, 1812.

Its climbing habits enable it to ascend trees, and in India it frequently nests among the branches. In some tropical islands *M. rattus* lives exclusively in the crowns of cocoa-nut palms, feeding almost entirely on their fruit.

Contrary to the opinion of Blandford, Oldfield Thomas thinks that the black rat originally came from India, and thence spread all over the world, exterminating the indigenous rats of other countries, only to be exterminated later by the arrival of the stronger *M. decumanus*. At the present time the last-named species is not yet established in some countries, for instance, in South America. On that continent, *M. alexandrinus*, a tropical variety of *M. rattus*, is waging war on the less highly organized native rice rats or Sigmodontes. *M. alexandrinus* has a gray, or rufous back, and a white belly.

M. rattus has a milder, more amenable, and tameable character than *M. decumanus*, and the white, or pied varieties, so dear to school boys, are of this species. It is cleanly in its habits, and the skin is kept in excellent order. Like other rats, it holds its food in its hands whilst eating, and it drinks by lapping.

Although the black rat is tending to be driven out by the brown rat, it still lingers on in some warehouses in London, at Yarmouth, in Sutherlandshire, I believe in Lundy Island, and I have been told it occurred not so very long ago on the island in the Serpentine. It doubtless occurs in many other places.

Mus decumanus, the so-called brown rat, undoubtedly comes from Central Asia, and at the present time there is a rat in China described under the name, *M. humiliatus*, which is so indistinguishable from the brown rat that is thought to be the parent form.

The migration westward of the brown rat certainly took place much later than that of the *M. rattus*. Its first appearance is difficult to date. Undoubtedly large hordes of them crossed the Volga in the year 1727, and continued their journey towards Central Europe. The following year, brown rats, according to Pennant, appeared in England—Jenyns says not till 1730—and it almost certainly came in ships, for on its journey overland it only reached Paris about the year 1750. Reaching England about the year of the second George's accession, and but thirteen years after the first of the House of Hanover succeeded to the throne, it was called, probably by the adherents of the Stuart cause, the Hanoverian rat. It was also called the Norwegian rat, possibly from the mistaken idea that it reached these islands from that country. It has now passed to the Northern half of the New World, where it is gradually driving out many of its weaker brethren. Its numbers are, however, kept within certain limits by

wolves, lynxes, racoon, coyotes, opossums, and other carnivora, and especially by the skunks which enter barns and outhouses in search of them.

Until the discovery of America, the rat and mouse were unknown in the New World, and the first rats who ever saw it are said to have been introduced in a ship from Antwerp.[1]

The brown rat is of a grayish-brown colour, tinged with yellow and white beneath. The tail is not so long as the body. It is a larger rat than *M. rattus*, has shorter ears, a more powerful skull, and 10 to 12 mammae. Its ears, feet, and tail are flesh-coloured. Like *M. rattus*, colour varieties occur often, the melanistic, not uncommon in Ireland, being sometimes mistaken for the black rat. It is a larger animal than its congener, more heavily built, with a more powerful head, and blunt jaw. The head and body measure some 8 to 9 inches, but the tail, as a rule, does not surpass the length of the body alone. Its weight averages about nine ounces. It is extremely fierce, and extremely cunning, and in the struggle for existence with allied species, has hitherto been consistently successful in its fight.

Mus decumanus is very prolific, and produce several litters a year, each averaging 8-10 in number, but 12 or even 14 young are not very uncommonly born at one time. It begins breeding young, a half-grown female producing a litter of three or four, but in Bombay the sexes do not breed until they have attained at least a weight of 100 grammes. The young are naked, *i.e.*, without hairs, and of a beautiful pink colour. They are blind, and their ears are gummed down over the auditory meatus. They are very weak and helpless, and need that maternal care, which, to do the female rat justice, is never withheld.

M. decumanus is less attached to the dwellings of man than *M. rattus*, still it does live in houses, though owing to a lack of climbing power, it is never found above the third floor. It is largely a burrowing animal, and makes its nests in its burrows. *M. rattus* can also burrow, but not so readily, and it nests not in the burrow, but in some obscure corner. The brown rat frequents barns, granaries, stables, slaughter-houses, rivers, ponds, ditches, drains, gullies, and sewers; it is, in fact, sometimes called the sewer rat. It is less particular in its food than the black rat, which are more usually found in grain stores. Although in Bombay the relative numbers of *M. rattus* caught to *M. decumanus* was as seven is to three, in open spaces, gardens, etc., the latter was much the commoner. Yet the report of the Plague Commission states that the authors "do not think it an exaggeration to state

[1] Ovalle's History of Chili, in Churchill's Voyages. III, 45.

that every inhabited building in Bombay City and Island, not excepting even the better class bungalows, shelters its colony of *M. rattus*."

Both species readily take to water, though *M. rattus*, being the better climber, more readily gets on shipboard. They will swim rivers and arms of the sea. The rats which infest the London Zoological Gardens are said to nightly swim the canal in Regent's Park. Rats constantly make their way to coastal islands, and in a comparative short time clear the place of indigenous rabbits and birds. Puffin Island, off the coast of Anglesey, and the Copeland Islands, in Belfast Bay, are two examples of islands at one time leased for the sake of their rabbits to people who had to give up the lease after the rats had landed on them. Similar cases are known off Denmark. They eat greedily birds' eggs, and are said to convey them over considerable distances, though how they do this is not very clear. After the destruction of the vertebrate land-fauna, they fall back upon the dwellers in the littoral, and live on prawns, shrimps and molluscs. They are very fond of fish, and Lyddeker, in the Royal Natural History, states that they occasionally catch and eat young eels. As their parasites show, they eat insects such as the meal-beetle, and when in the field they eat land-snails, insect larvae, and other food, which conveys into their bodies the same tape-worms, etc., which we find in the hedgehog and in the smaller carnivora.

They are, in fact, omnivorous, and nothing in the way of human food is alien to them. They do enormous harm to corn ricks and to stored grain. They are inveterate enemies to the hen roost, the pigeon house and, as we have seen, to the rabbit warren. When pressed by hunger they readily turn cannibal, and the brown rat easily masters the black. There are stories of some few specimens of each species being left in a cage overnight; on the following morning there were only brown rats. To some extent they help to keep down the field mice (Genus *Microtus*), and this is especially the case in North America,[1] but the benefit is doubtful since they are held to be at least as destructive to the crops as the field mice, and probably more so.

The ferocity with which they defend themselves when attacked is well known, and at times, when they are driven by hunger, do not hesitate to attack man. They are said to nibble the extremities of infants, and on one—apparently authentic—instance they overcame and devoured a man who had entered a disused coal mine tenanted by starving rats. The bite is said to be severe (they will bite through a man's thumb nail into the flesh) and to be long in healing.

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[1] An economic study of Field Mice (genus *Microtus*). Dr. Lantz, U.S. Dept. of Agric., Biol. Survey. Bull. 31.

Rats eat much garbage and offal, and readily feed upon dead bodies. About sixty years ago there stood at Monfaucon, a slaughter-house for horses, and this it was proposed to remove still further from Paris. It is stated that the carcases of the horses slaughtered, which sometimes amounted to thirty-five a day, were cleared to the bone by rats in the course of the following night. This excited the attention of a Mons. Dusaussois, who made the following experiment: He placed the carcases of two or three horses in an enclosure, which permitted the entrance of rats by certain known and closable paths. Towards midnight he and some workmen entered the enclosure, closed the rat-holes, and in the course of that night killed 2,650 rats. He repeated the experiment, and by the end of four days had killed 9,101 rats, and by the end of a month 16,050 rats. During the process of these experiments other carcases were exposed in the neighbourhood, so that in all probability Mons. Dusaussois attracted to his enclosure but a small proportion of the total available number of rats. All around this slaughter-house the country was riddled with extensive burrows, so that the earth was constantly falling in. In one place the rodents had formed a pathway 500 yards long leading to a distant burrow.

A rat census can never be taken, but estimating that there is one rat for every human being on these islands, or less than one rat for every acre of ground, a moderate estimate would give us 40,000,000 rats at any one time. It has been calculated that a rat does at least 7s. 6d. worth of damage during the course of the year, hence in Great Britain and Ireland we may annually charge them with a loss of at least £10,000,000.

From what has been said it is obvious that rats cause enormous damage to humanity, which is counterbalanced by the almost infinitesimal good they do as scavengers. I do not propose to consider in detail the harm they do as disease carriers, but I would remind you that the rat is the primary host of *Trichinella spiralis*, Owen, which, when conveyed from the rat to the pig, and—by eating uncooked or imperfectly cooked pork—from the pig to man causes severe and very fatal epidemics, and enforces the expenditure of large annual sums on meat inspection. They also convey a virulent form of equine influenza from one stable to another, and the "foot and mouth" disease. But what is infinitely more important than all the other injuries of all kind put together is the harm they bring to suffering humanity by conveying the bubonic plague from one patient to another. The plague under which India and great parts of Burmah is "groaning and travailing," is caused by a specific bacillus discovered in 1894 by Yersin at Hong Kong. It flourishes in other vertebrates besides man and the rat, but

owing to the migratory habits of the latter, the rat is the most effective agent in the spread of the disease. Both species of rat seem about equally susceptible, and the presence of the microbe showed no special relation to either the age or the sex of either species. The microbe is conveyed from rat to man by a flea. (v. p. 70).

The destruction of the rat is now being urged on all hands, and in the near future we shall probably see a considerable diminution in their numbers in the more civilized countries of the world. This will mean a considerable upset in the balance of power of the almost hidden fauna which surround us on all hands. It may even, as the Medical Officer of Health for Bristol has pointed out, lead to an increase of immigration of ship rats, those most likely to be infected by plague, to take up the places vacated on land by the slain. By one of those commercial agencies—I don't propose to go into the merits of any one of them—which the enterprise of our merchants is now pressing on the public, a large landed proprietor a few months ago completely freed his buildings of rats and mice. A few weeks later his house and outbuildings were overrun by swarms of what to him—for in the time of the rats and mice he had never seen one—was a new and formidable insect. He sought the aid of the Royal Agricultural Society, who referred the matter to their scientific adviser, who pronounced the insects to be cockroaches!

In the eighteenth century, among the officers of his "British Majesty," was an official rat-catcher, whose special uniform was scarlet, embroidered in yellow worsted, with figures of field mice destroying wheat sheaves. Enquiry at the Lord Chamberlain's office has satisfied me that the officer still exists and still catches rats, but I fear the uniform has been abolished. However, a book has recently appeared dealing officially and exhaustively with all matters of this kind, and as soon as I can come by it I will look the matter up. Should this dignified uniform have really disappeared, might not a humble petition be presented that it be revived? Surely never more than at the present time should the honour and glory of the rat-catcher be exalted.

ECTOPARASITES OF THE RAT.

INSECTA.

A. Siphonaptera (Fleas).[1]

1.—**Ceratophyllus fasciatus,** Bosc.

This is the flea most commonly found on *Mus rattus* and on *M. decumanus* in Great Britain and indeed throughout Central and Northern Europe. It also occurs on the house-mouse *M. musculus*. Rats from Cape Town also harbour this species, and it is occasionally found on rats from India.

2.—**Ceratophyllus londiniensis,** Rothschild.

Synonym. *Ceratophyllus italicus*, Tiraboschi.

Very common on both species of rats and allied forms. Apparently this species does not bite man.

3.—**Ceratophyllus consimillis,** Wagner.

4.—**Ceratophyllus lagomys,** Wagner.

5.—**Ceratophyllus mustelae,** Wagner.

6.—**Ceratophyllus penicilliger,** Grube.

Numbers 3, 4, 5 and 6 are all very common fleas on *Mus decumanus*, though Tiraboschi has not found them in Italy. Systematically they are allied to *Ceratophyllus faciatus*, Bosc.

7.—**Ctenocephalus canis,** Curtis.

Occurs chiefly on the dog, but has been found on many Carnivores, on hares and rabbits, monkeys and man, and the rat. In Italy some 25-30 per cent. of rat-fleas belong to this species. The members of it are unusually agile and are great jumpers.

8.—**Ctenocephalus felis,** Bouché.

Found on cats and also on rats; like the preceding species, it is found widely distributed in the Old World. Mr. Rothschild tells me there is no doubt that these two species are distinct.

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[1] Rothschild, N. C. Jour., *Hygiene* vi, 1906, p. 483.

9.—**Ctenopsylla musculi,** Duges.

Is the commonest flea found on the domestic mouse in our country, and it sometimes makes its way to the rat; it has been taken from *M. rattus* in Pretoria, and in Italy is the commonest flea on that species. It seems to be cosmopolitan in its distribution.

10.—**Dermatophilus caecata,** Enderlein.

The genus *Dermatophilus* (Guerin) Rothschild, with the genera *Echidnophaga* and *Hectopsylla*, comprise the family SARCOPSCYLLIDAE, which includes the Jiggers or Chigos, whose females burrow in the skin. *D. caecata* is recorded from *Mus rattus* taken in San Paulo in Brazil.

11.—**Echidnophaga, rhynchopsylla,** Tiraboschi.

Synonym. *Echidnophaga murina*, Rothschild.[1]

This flea, which Dr. Tiraboschi found on *Mus rattus* in Italy, usually upon the heads and snout, is interesting because it, with *E. gallinacea*, are the only two species of the family SARCOPSYLLIDAE so far recorded in Europe. It is nearly allied with *E. gallinacea.* The females all had their heads solidly embedded in the skin of the host.

12.—**Echidnophaga gallinacea,** Westwood.

Synonym. *Echidnophaga gallinacea*, Tiraboschi.
Argopsylla gallinacea, Baker.
Echidnophaga gallinacea, Rothschild.

Tiraboschi has taken this, which he considers a species distinct from *E. rhynchopsylla* from *Mus rattus* in Italy.

13.—**Neopsylla bidentatiformis,** Wagner.

Taken on *Mus decumanus* in the Crimea and on *Spermophilus* sp. in Siberia and the Caucasus.

14.—**Loemopsylla cheopis,** Roths., 1903.[2]

Synonym. *Pulex murinus*, Tiraboschi.
Pulex pallidus, Tidswell.
Pulex philippinensis, Herzog.
Pulex brasiliensis, Baker.

This flea was described by Rothschild from specimens taken from numerous small rodents in Egypt. Tiraboschi found it commonly in

[1] Rothschild, N. C., Rep. Thompson Yates and Johnston Lab., Liverpool, vii (new ser.), 1906, p. 55.

[2] Jordan, K. and Rothschild, N. C., Parasitology, 1908, vol. i, p. 42.

Italy, and on 40% of the ship rats in Genoa. It occurs on from 80% to 90% of the rat population of Sydney and Brisbane, where it was described by Tidswell[1] under the name of *Pulex pallidus*, and on 25 per cent. of the rats in Marseilles, where Gauthier and Raybaud[2] record that the numbers decrease as the distance from the water-front increases. Herzog[3] took 42 fleas of this species from 153 rats of both species in Manila, and it also occurs commonly in South America. It has been found at Plymouth and at Pretoria. It is by far the commonest of the rat fleas of warmer countries, and the Plague Commission consider that it forms 99 per cent. of the fleas found on *Mus rattus* and *M. decumanus* in India.

This species readily passes on to monkeys, guinea-pigs, and man, and we have seen it lives on many wild rodents. It is now recognized as the chief means by which the plague is conveyed from rats to man.

15.—**Pulex irritans**, Linn.

This, the common human flea, has been found biting both *Mus rattus* and *M. decumanus*, as well as many other animals which come in contact with man.

According to this list the following species occur on *Mus decumanus*, but not on *Mus rattus*:—*Ceratophyllus consimilis*, *C. lagomys*, *C. mustelae*, *C. penicilliger* and *Neopsylla bidentatiformis*; whilst *Dermatophilus caecata*, *Echidnophaga rhynchopsylla* and *E. gallinacea* occur on *Mus rattus* and not on *Mus decumanus*. Further investigations will very likely reduce these two lists.

B. Anopleura—Lice.

Enderlein[4] has recently separated out from the genus *Haematopinus* certain forms which he places in two new genera *Hoplopleura* and *Polyplax*.

16.—**Hoplopleura acanthopus** (Drury).

Synonym. *Haematopinus acanthopus*, Drury.

This is figured and described by Tiraboschi[5]; it occurs on *Mus decumanus*, on the mouse, and on several species of wild Muridae.

[1] Tidswell, F., Report on the Second Outbreak of Plague at Sydney, 1902, by Ashburton Thompson.

[2] Gauthier and Raybaud, Rev. d'Hygiène xxv, 426.

[3] Herzog, M. Zeitschr. Hygiene, li, p. 268.

[4] Zool. Anz., xxviii 1904-5, pp. 121, 220, 626, and xxix, 1905-6, p. 192.

[5] Arch. parasit. viii, 1903-4, p. 318.

17.—**Polyplax spinulosus** Burm.

Synonym. *Haematopinus spinulosus*, Burm.

This louse has been found by many observers on *Mus decumanus*, and has been recently figured and described by Tiraboschi.[1] It is believed to act as the intermediate host of *Trypanosoma lewisi.*

18.—**Pediculus capitis,** Nitzsch.

This species is thought occasionally to infest the rat. They are known to suck the blood of rats when placed on them, and they are capable of transferring the plague to man. It is thought that this may be not unfrequent amongst the sect known as Janis, to whom all life is sacred, and who are consequently exceptionally verminous.

ARACHNIDA.

ACARINA.

DEMODICIDAE.

19.—**Demodex musculi,** Oudemans.[2]

It seems doubtful if this is but a variety of *Demodex folliculorum*, which lives in the sebaceous glands and hair follicles of man. It has been found in the mouse and in rats, but the species is not stated

IXODIDAE.

20.—**Ixodes ricinus,** L.

Synonyms. *Acarus ricinus*, L.
Ixodes rufus, Koch.
Ixodes sulcatus, Koch.
Ixodes sciuri, Koch.

This, one of the commonest of ticks in temperate climes, and one which occurs on a very large number of very diverse animals, has been recorded by Neumann on *Mus decumanus.*

21.—**Hyalomma aegyptium,** L.

Synonyms. *Acarus aegyptius*, L.
Ixodes aegyptius, Andouin.
Hyalomma marginatum, Koch.
Hyalomma aegyptium, Canestrini.

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[1] Arch. parasit. viii, 1903-4, p. 316.
Tijdschr. Ent. 1897.

Larval specimens of this genus have been identified by Professor Nuttall, which was collected off *Mus rattus* in Nowshera, North-West Frontier Province, India. This species is commonest on cattle. It also occurs on man, and gives rise to serious fevers.

22.—**Rhipicephalus sanguineus**, Latr.

Synonyms. *Ixodes sanguineus*, Latr.
Ixodes dugesi, Gerv.
Rhipicephalus sanguineus, Koch.
Rhipicephalus siculus, Koch.

Adult forms of this species occurred on the same rats as did the *Hyalomma aegyptium*, and were also identified by Professor Nuttall. It infests cattle, sheep, dogs, cats, and occasionally man. This species is common in Italy and France.

GAMASIDAE.

23.—**Laelaps agilis**, Koch.

Found on *Mus decumanus* and many other allied forms. The members of the genus *Laelaps* suck blood.

24.—**Laelaps echidninus**, Berlese.

Synonyms. *Laelaps agilis*, Koch.
Haemomyson musculi, Megnin.

Common on *Mus decumanus* and *Mus rattus* in all parts of Italy. It occurs in large numbers, 150-200 on a single rat.

25.—**Laelaps stabularis**, Koch.

Synonyms. *Gamasus stabularis*, Koch.
Gamassus complanatus, Kramer.
Gamassus fenilis, Megnin.
Hypoaspis stabularis, Canestrini.

This form, common in stables, has been found on *Mus decumanus*.

26.—**Myonyssus decumani**, Tiraboschi.[1]

A single adult female, taken on a *Mus decumanus*, captured at Rome, was described and figured by Tiraboschi. Members of this genus are true parasites, living on the blood of their host.

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[1] Arch. Parasit. viii, 1903-4, p. 337.

SARCOPTIDAE.

27.—**Notoedres alepis,** Railliet and Lucet.[1]

Synonym. *Sarcoptes notoedres var muris*, Megnin, 1820.
Sarcoptes alepis, Raill. and Luc., 1893.
Notoedres muris, Can., 1894.
Notoedres notoedres, Can and Kramer, 1899.

This species lives in the ears, and on the external genital organs of *Mus decumanus* and of *Mus rattus*, and other Muridae in France, but it does not appear to do much harm. The genus *Notoedres* is allied to *Sarcoptes*, the itch-mite, and they have similar habits.

TROMBIDIDAE.

28.—**Myobia ensifera,** Poppe.

Found on a *Mus decumanus* from a house, also on white rats. It is not impossible that this and the succeeding species are identical.

29.—**Myobia musculi** Schrank.

Synonyms. *Pediculus musculi*, Schrank.
Myobia coarcta, Heyden.
Myobia musculi, Claparède.

This is commoner on the mouse, living at the base of the hairs on the head, but Megnin also records it on the *Mus decumanus*.

ENDOPARASITES OF THE RAT.

PROTOZOA.

The number of Protozoa recorded as parasitic in the rat is disappointingly small, and a renewed search would doubtless largely increase the number. In his exhaustive article on Sporozoa in Lankester's "Treatise of Zoology," Profesor Minchin mentions but one Protozoan parasite *Sarcocytis* sp. (Siehold, 1853) from the rat, though he records three from the mouse. Professor Minchin has kindly sent me the names of some more protozoan endoparasites, which are mentioned below, but I feel sure the list is by no means exhaustive.[2]

[1] C. R. Soc. Biol., 1893, p. 404.

[2] See also "Observations on the Protozoa in the Intestine of Mice," by C. M. Wenyon, Arch. Protistenk. Festb. z, R. Hertvig, Suppl. I, p. 169. Many of the Protozoa described here probably also invest the Rat.

1.—**Amoeba muris**, Grassi.[1]

The life-history of this form, which occurs in mice as well as rats, has recently been described by Wenyon.

2.—**Leucocytozoon muris**, Balfour.[2]

Balfour has described this species from *Mus decumanus*, finding it in two specimens out of a dozen examined. It occurred in the blood of the heart and of the spleen, and free forms were found as well as those living in the leucocytes.

3.—**Sarcocystis**, s.p.

This parasite was first found by Meischer in the muscles of a house mouse, and is figured and shortly described by von Siebold,[3] who found specimens, as did also Herr Bischoff, in the muscles of a rat —species not mentioned. It is possible that this incompletely described Sarcosporidian is identical with *Sarcocystes muris* (Blanchard), a very deadly parasite in mice, according to Koch.[4] A virulent poison has been extracted from a Sarcosporidian parasitic in the sheep by Laveran and Mesnil, and named by them *sarcocystin.*

4.—**Piroplasma muris**, Fantham.[6]

Fantham has made a careful study of certain phases in the life-history of this blood parasite, which he found in the blood of the *Mus rattus*, the white variety. It occurred but seldom in the peripheral circulation, and was most plentiful in the red corpuscles of the blood in the capillaries of the viscera and nervous system, especially in the liver, kidneys, and spleen. Extra-corpuscular forms occurred in groups. The complete life-history of this form has not been worked out.

5.—**Trypanosoma lewisi**, Kent.

The history of this common parasite of the rat is given in Laveran and Mesnil's "Trypanosomes et Trypanosomiases."[7] The infection seems to occur all over the world, in both *Mus decumanus* and *Mus rattus*, but the percentage of infected rats varies greatly in different

[1] Atti. Soc. Ital. Sci. Nat., xxiv, 1882, p. 181.

[2] Grassi's authority. Second Report of the Welcome Research Laboratories, Khartoum, 1906, p. 110.

[3] Zeitschr. wiss. Zool., v, 1854, p. 199.

[4] Verh. v. Int. Congr. Zool., Berlin, 1901 (1902), p. 674.

[5] CR. Soc. Biol., Paris (II) i, 1899, p. 311.

[6] Quart. J. Micr. Sci., L, 1906, p. 493.

[7] Paris, 1904.

localities, and at different times. Nuttall[1] recalls the experiments of Rabinovitch and Kempner (1899), who claim to have infected healthy rats by placing on them fleas taken from the bodies of infected specimens. The species of flea is not mentioned. Prowazek (1905) has observed the development of *Tr. lewisi* in one of the rat-lice, *Polyplax spinulosus*, and though he did not succeed in transmitting the disease from rat to rat by means of lice, he concluded that such conveyance was possible in certain cases.

METAZOA.

The following Nematodes and Cestodes entozoa have been found in the *Mus rattus* :—

A. NEMATODA.

6.—**Heterakis spumosa,** Schneider.[2]

This species is found in the caecum and large intestine of both *M. rattus* and *M. decumanus*. The male attains a length of 7 mm., the female of 9 mm.

7.—**Oxyuris obvelata,** Bremser.

Synonym. *Ascaris oxyura*, Nitzsch.[3]

This small thread worm measures in length in the male 1.6 mm., in the female 3-5 to 5-7 mm. It lives in the intestine, mostly in the large intestine. It inhabits many species of *Mus* and of *Arvicola*, also *Spermophilus citillus*, and is much commoner in the "country mouse" than in the "town mouse." As is usual the males are less abundant than the females, but are more easily found than is usual in this genus. The worms swell up, and sometimes burst by the osmotic absorption of water when placed in that fluid.

8.—**Physaloptera circularis,** von Lins.[4]

This species, which measures in the female 24 mm., and in the male 15.2 mm., was described by von Linstow from specimens taken from the stomach of a *M. rattus* collected in Madagascar bv F. Sikora. Von Linstow mentions that with the exception of *Ph. muris brasiliensis*, Molin, it is the only *Physaloptera* which inhabits rodents.

[1] Ber. ü. d. xiv, Intern. Kongr. f. Hyg. u. Demogr, Berlin, 1907, p. 200.

[2] Schneider, A. Monog. d. Nemat. Berlin, 1866. p. 77.

[3] Ersh. u. Grub. Encyclop., vi, p. 84; Creplin, Wiegmann's Archiv., 1849, p. 56; Dujardin, Hist. Nat. d. Helminthes. Paris, 1845, p. 141; Diesing Syst. Helminth., Vienna, 1851, p. 145.

[4] Arch. Naturg., lxiii, i, 1897, p. 28.

9.—Spiroptera brauni, von Lins.[1]

This species was also described and figured by von Linstow, and from a *M. rattus* taken in Madagascar. The male measures 19 mm. in length, the female 54 mm.

10.—Spiroptera ratti, Diesing.[2]

This species is mentioned in von Linstow's Compendium, but I have been unable to find the magazine in which it is described in any of the Cambridge libraries. *S. ratti* lives in the urinary bladder.

11.—Spiroptera sp., Bakody.[3]

This insufficiently described species is mentioned in a letter by Dr. Bakody of Pesth. He describes it as encapsuled in the walls of the alimentary canal, and in certain muscles of both *M. rattus* and *M. decumanus.*

12.—Trichocephalus nodosus, Rud.[4]

The male is 14-20 mm. in length, the female 23-31 mm.; the eggs, with the characteristic "tampons" at each end, measure 0.57 by 0.62 mm. This species occurs in *M. rattus*, and the house mouse *M. musculus*, and the wood mouse *M. sylvaticus*, and in species of *Arvicola.* It lives in the caecum, but is sometimes found in the intestine.

13.—Trichosoma annulosum, Duj.[5]

This form is shortly described by Eberth, and is figured by him. It occurs in the duodenum and small intestine of both *Mus rattus* and *M. decumanus.* Its development is probably direct, without the intervention of an intermediate host.

B. CESTODA, ADULT FORMS.

14.—Cattotaenia pulsilla, Goeze.[6]

Synonym. *Taenia pulsilla*, Goeze.

This species lives in the small intestine of *Mus rattus* and *M. decumanus.* For it von Janicki has recently established the new genus *Cattotaenia.*

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[1] Arch. Naturg., lxiii, i, 1897, p. 30.

[2] Gurlt, Magaz. für d. gesammete Thierheilk., 1838, p. 226.

[3] Archiv path. Anat. u. Physiol., xxxvi, 1866, p. 435.

[4] Dujardin, Hist. Nat. d. Helminthes., Paris, 1845, p. 35; and Goeze, Naturg. d. Eingeweidew. Blankenburg, 1782.

[5] Eberth, C. J. Untersuch. über Nematoden, Leipzig, 1863, p. 57.

[6] Goeze, J. A. E., Naturg. d. Eingeweidewürmer, Blankenburg, 1782. Archiv. Naturg. 1862, I. p. 205., von Janicki, C. Zeitschr. wiss. Zool., lxxxi, 1906, p. 575, and Zool. Anz., xxxviii.

15.—**Hymenolepis diminuta**, Rudd.[1]

Synonyms. *Taenia diminuta*, Rud, 1819.
Taenia leptocephala, Creplin, 1825.
Taenia flavo-punctata, Weinland, 1858.
Taenia varesina, Parona, 1884.
Taenia minima, Grassi, 1886.

The length of this worm is from 20-60 cms. Its second host lives in various insects, a butterfly *Asopia farinalis*, an Orthopteron *Anisolabis annulipes*, and certain beetles *Akis spinosa* and *Scaurus striatus*. Of these perhaps the first is the more frequent intermediary. The worms can be found in the rat's intestine three days after it has fed on infected insects; they attain a length of 5 mm., and at the end of fifteen days they have well-developed proglottides. *H. diminuta* occurs in the intestine of *Mus rattus*, *M. decumanus*, *M. musculus*, *M. alexandrinus*, and occasionally of man. It forms one of the three unarmed species of *Hymenolepis* which infest the genus *Mus*.

16.—**Hymenolepis microstoma** Duj[2]

Synonym. *Taenia microstoma*, Duj.

The length of this worm is 162 mm. It lives in the intestines of *Mus rattus* and *M. musculus*. It is one of the four armed species of *Hymenolepis* which live in the genus *Mus*.

17.—**Hymenolepis murina** Duj.[3]

Synonym. *Taenia murina*, Duj, 1845.
H. [Lepidotrias] murina, Weinland, 1861.

This worm measures from 25-40 mm. Grassi considers this species as identical with *H. nana* of the small intestine of man. He further thinks that *H. murina* develops without an intermediate host, and claims to have infected rats by feeding them on the mature proglottides of the worm. He describes the larval stages as developing in the thickness of the mucosa at the base of the villi. Here they increase markedly in size, and turn into cysts, which ultimately rupture the mucosa in which they are imbedded, and make their way into the intestine, where they

[1] Dujardin, M. F. Hist. nat. des Helminthes., Paris, 1845, p. 580, and Zschokke, F. Recherches sur la structure des Cestodes. Geneva, 1888., von Janicki, C. Zeitschr. wiss. Zool., lxxxi, 1906, p. 581.

[2] Dujardin, M. F., Hist. nat. des Helminthes, Paris, 1845, von Janicki Zeitschr, wiss. Zool., lxxxi, 1906, p. 581.

[3] Dujardin, M. F., Hist. nat. d. Helminthes., Paris, 1845, von Janicki, C. Zeitschr, wiss. Zool., lxxxi, 1906, p. 581.

quickly become adults. If this life-history be true, it forms an exception—unique as far as I know—of a cestode which passes both its larval—cysticercus—and its adult—scolex—stage within the body of one and the same host. *H. murina* occurs in *Mus rattus*, *M. decumanus*, *M. pumilus*, *M. musculus*, and *Myoxus quercinus*. Rats infested with *H. murina* are particularly resistant to the attacks of other Cestodes. It is one of the four armed species of *Hymenolepis* which inhabit the genus *Mus*.

18.—**Taenia ratti**, Rud.[1]

This form again wants reinvestigation. It occurs in the intestine of *Mus rattus*. Von Janicki considers it a species of very doubtful validity.

19.—**Taenia umbonata**, Molin.[2]

Another intestinal form which occurs in *Mus rattus* and *M. musculus*. Von Janicki[3] considers this a doubtful species, and Blanchard[4] thinks it may be identical with *Cattotaenia* (*Taenia*) *pulsilla*.

20.—**Bothriocephalus ratticola**, von Lins.[5]

This animal was found encysted in the liver of a rat from Singapore. It measured 12 cms., but is undoubtedly a larval form, such as is common in fish.

CESTODA, Larval Forms.

21.—**Taenia crassicollis**, Rud, 1810, larval form **Cysticercus fasciolaris.**

The adult form of this tape-worm is a parasite of the small intestine of the cat, both wild and domesticated, and also of some species of *Putorius*. The larval form—*Cysticercus fasciolaris*—has a very small cyst, from which the head protrudes, followed by a long, and clearly ringed neck, but without, as yet, any trace of reproductive organs. The length of the worm varies from 3-20 cms. On being swallowed by a cat the small vesicle and these rings are absorbed, and the proglottides are formed anew at the base of the head. The cysticercus occurs in the liver of rats, mice, and bats.

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[1] Rudolphi, C. A., Entozoorum Synopsis, Berolini, 1819.

[2] SB. Ak. Wien, xxx, 1858, p. 132.

[3] Zeitschr, wiss. Zool., lxxxi, 1906, p. 582.

[4] Hist. Zool. et méd des Témiadés du genre *Hymenolepis*. Bibl. gèn. de Médecine. Paris, 1891.

[5] Centrbl. Bakter., xxxvii. 1904, p. 682.

22.—**Taenia solium,** L. larval form **Cysticercus cellulosae.**

The cystic form of *T. solium*, usually found in pork, is from time to time found also in the rat, encysted in the peritoneum. There is nothing surprising in this as rats are omnivorous, eating every kind of garbage, and frequenting both the homes of humanity and the styes of pigs.

C. ACANTHOCEPHALA.

23.—**Gigantorhynchus moniliformis,** Bremser.[1]

Synonym. *Echinorhynchus moniliformis*, Bremser.

This species of Acanthocephalan inhabits various species of *Arvicola*, *Cricetus* the Hamster, *Myoxus*, and *Mus*, including *M. rattus* and *M. decumanus*. It can also infest man. The larval stage is passed in the common beetle *Blaps mucronata*, Latr.

The following Entozoa live in the brown, Hanoverian, Norwegian rat, *Mus decumanus*:—

A. NEMATODA.

24.—**Filaria obtusa,** Rud.[2]

Synonyms. *Spiroptera obtusa*, Rud.
Spiroptera murina, Leuck.

These Nematodes are found sometimes in great numbers in the stomachs of *M. decumanus* and *M. musculus*. The female averages 40 mm. in length, the male 28 mm.

25.—**Filaria rhytipleuritis,** Deslongchamps, 1824.

This form has been found in the stomach of *M. decumanus;* its larval stage is believed to be the *Mermis blattae orientalis* of Diesing, which occurs in the fat-bodies of the blackbeetle *Periplaneta orientalis*[3] The female attains a length of 20 mm., the male is shorter. *Mus rattus* has been artificially infected with this thread-worm, and probably it is readily infected in nature.

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[1] Bremser, J. C., Icones Helminthum, Vienna, 1824. Hamann, O. Zool. Anz., xv. 1892, p. 165.

[2] Schneider, A. Monog. d. Nematoden. Berlin, 1866, p. 97.

[3] Galeb, O., C. R. Ac. Paris, lxxxvii, 1878, p. 75.

26.—**Filaria sp.** Davaine.[1]

Darvaine is said to have mentioned some microfilarias he had discovered in the blood of the rat, but their parentage is still a matter of doubt. I have not succeeded in finding the place referred to.

27.—**Heterakis spumosa,** Schneider.

v. No. 6, p. 75.

28.—**Oxyuris obvelata,** Bremser.

v. No. 7, p.75.

29.—**Spiroptera sp.** Bakody.

v. No. 11, p. 76.

30.—**Strongyloides longus,** Grassi and Segrè.[2]

Synonym. *Rhabdonema longum*, Grassi and Sergè.

This form is larger than the *Str. intestinalis* of the human intestine. Its length is variable, but may reach 6 mm. It was first found in the rabbit, but has since been recorded from the sheep, the pig, the weasel, the pole-cat, and the brown rat. The development is direct, without the intervention of any intermediate host.

31.—**Trichina circumflexa,** Polonio.[3]

This form, which may very probably be identical with *Trichinella spiralis*, is mentioned by von Linstow as a parasite of *M. decumanus*, but Polonio attributes it to *Mus rattus*, probably both act as hosts. It occurs encapsuled in the peritoneum.

32.—**Trichinella spiralis,** Owen.

Synonym. *Trichina spiralis*, Owen.

This is the most important of the metazoan parasites of the rat from the human point of view, since the rat is probably the natural host from which the pig and man acquire the terrible disease of Trichinelliasis. The embryos occur encysted in the muscles, and the adults live in the intestine. It is also found in the hamster, the mouse, and other rodents.

33.—**Trichocephalus hepaticus,** Bancroft.[4]

Bancroft describes the livers of rats fed on large numbers of eggs of this worm as becoming riddled with the adults, which cause death

[1] Davaine Traité des Entozoaires.

[2] Rend. Ac. Lincei (4), iii, p. 100, 1887.

[3] Lotus, 1860, p. 23.

[4] P. R. Soc. N.S. Wales, xxvii, 1893, p. 86.

in three to four weeks. The worms are 40-50 mm. in length. The development is direct without intermediate host.

I think there is little doubt that this form is identical with *Trichosomum tenuissimum* described by Leidy[1] two years before.

34.—**Trichodes crassicauda,** Bellingham.[2]

Synonym. *Trichosoma crassicauda,* Bellingham.

This worm lives in the urinary bladder, the kidneys, the ureter of *Mus decumanus.* It is described and figured by von Linstow, who says the eggs, whilst unlaid, contain embryos with a boring spine, which can be protruded and retracted. The development is probably direct. Sometimes the worms, which may be numerous, are free in the bladder sometimes attached to the wall, they are often enveloped in mucous. The males, which are very small, are said to live like the males of *Bonellia,* in the uterus of the female, three or four at a time.

35.—**Trichosoma annulosum,** Duj.

v. No. 8, p. 76.

36.—**Trichosoma papillosum,** Polonio.[3]

This is also a parasite of the urinary bladder, and may prove to be a synonym of *Trichodes crassicauda.*

37.—**Trichosoma schmidtii,** v. Lins.[4]

Von Linstow has described and figured the male of this species, which appears to be very small and very rare. It lives in the urinary bladder of *M. decumanus.*

38.—**Trichosoma tenuissimum,** Leidy.[5]

Synonym. *Trichocephalus hepaticus,* Bancroft.

v. No. 33, p. 80.

39.—**Trichosoma sp.** Railliet.[6]

This form also seems to me to be, in all probability, identical with Leidy's *Trichosoma tenuissimum,* v. No. 10 p. 80. An identical or closely similar form makes tumours in the liver of the hedgehog.

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[1] P. Ac. Philad., 1890, p. 412.

[2] Eberth, J. Untersuchungen über Nematoden. Leipzig. 1863, p. 61. von Linstow, O. Arch. Naturg., xlviii, i. 1882, p. 12.

[3] Lotos, 1860, p. 23.

[4] Arch. Naturg., xl, i. 1874, p. 271.

[5] P. Ac. Philad., 1890, p. 412.

[6] Bull. Soc. Zool., France, xiv, 1889, pp. 62 and 360.

B. TREMATODA.

40.—**Distoma spiculator,** Duj.[1]

Under the above name Dujardin describes six immature individuals which he found in the small intestine of a specimen of *M. decumanus* taken at Rennes. He somewhat curiously adds that he believes them to be young specimens of *D. trigonocephalum,* since the rats in the country devour molluscs and insects as much as do small carnivora, hedgehogs, etc., which harbour the trematode.

C. CESTODA, ADULT FORMS.

41.—**Cattotaenia pulsilla,** Goeze.

v. No. 14, p. 76.

42.—**Hymenolepis diminuta,** Rud.

v. No. 15, p. 77.

43.—**Hymenolepis horrida,** v. Lins.

Synonym. *Taenia horrida,* v. Lins.[2]

Length 80 mm. This is one of the unarmed forms, and is allied to *H. relicta* and *H. diminuta.*

44.—**Hymenolepis murina,** Duj.

v. No. 17, p. 77.

45.—**Taenia brachydera,** Dies.[3]

This worm was found in the small intestine of the *Mus decumanus* in Ireland by Dr. O'B. Bellingham.[4] Von Janicki[5] considers it a doubtful species, and mentions that Blanchard thinks it may be identical with *H. microstoma.*

CESTODA, LARVAL FORMS.

6.—**Taenia crassicollis,** Rud, 1810, larval form **Cysticercus fasciolaris.**

v. No. 21, p. 78.

[1] Dujardin, M. F. Histoire Naturelle des Helminthes, Paris 1845, p. 424.

[2] Arch. Naturg, lxvii, i, 1901, p. 1.

[3] S.B Ak. Wien, xiii, 1854, p. 607.

[4] Ann. Nat. Hist., xiv, 1844, p. 322.

[5] Zeitschr, wiss. Zool., lxxxi, 1906, p. 582.

[6] Hist. zool. et. med. des Téniades du genre *Hymenolepis.* Bibl. gèn. de Médecine. Paris, 1891.

D. ACANTHOCEPHALA.

1.—**Gigantorhynchus moniliformis** Bremser.

v. No. 23, p. 79.

The Cestoda of the Genus Mus.

Von Janicki has recently put together a list of the adult Cestodes inhabiting the intestines of various members of this genus. Apart from some species insufficiently described, the list contains the following species; the names of those underlined occur in *Mus rattus* and *Mus decumanus*, or in one of them:—

i. Cattotaenia pusilla, Goeze, in both rats.
ii. Davainea blanchardi, Parona.
iii. Davainea celebensis, Janicki.
iv. Davainea polycalceola, Janicki.
v. Davainea gracilis, Janicki.
vi. Davainea trapezoides, Janicki.
vii. Hymenolepis contracta, Janicki, *M. decumanus.*
viii. Hymenolepis microstoma, Dujardin, *M. rattus.*
ix. Hymenolepis murina, Dujardin, in both rats.
x. Hymenolepis muris variegati, Janicki.
(vii.–x.) with armed heads.
xi. Hymenolepis diminuta, Rudolphi, in both rats.
xii. Hymenolepis horrida, von Linstow, *M. decumanus.*
xiii. Hymenolepis relicta, Zschohke.
(xi.–xiii.) with unarmed heads.
xiv. Hymenolepis crassa, Janicki, *M. decumanus.* Scolex unknown.
xv. Hymenolepis, sp., Janicki, *M. decumanus.*

There are further certain doubtful species, amongst which von Janicki reckons *Taenia ratti*, Rud., *T. muris sylvatici*, Rud., *T. muris capensis*, Rud., *T. musculi. Ptychosphysa* (*Mesocestoides*) *lineata*, Goeze = (*Taenia canis lagopodis*, Viborg), though said to occur in *Mus musculus*, apparently does not do so. The *Taenia imbricata* of Diesing and the *T. umbonata* of Molin are thought to be identical with *Cistotaenia pusilla*, Goeze, whilst *T. brachydera*, Diesing, is probably synonymous with *Hymenolepis microstoma.*

Cambridge, July, 1908.

THE LIFE-HISTORY OF SYAGRIUS INTRUDENS, WATERH.

A Destructive Fern-eating Weevil.[1]

By

JOSEPH MANGAN, B.A., A.R.C.Sc. I.

With Plates VI and VII.

THE following description of the larva, pupa, and imago of *Syagrius intrudens*, may be of interest in view of the possible importance of that, and perhaps of allied species, to those concerned with the culture of Ferns. Up to the present it has been recorded solely from the Royal Botanic Gardens, Dublin, where, however, it has proved to be a most persistent and exceedingly destructive pest. For some time the Keeper of the Gardens, Mr. F. W. Moore, was troubled by the decided falling off and even complete collapse of very many of the exotic specimens in the fern-houses; the cause of these failures being by no means apparent, until an examination of the rhizomes of plants that had succumbed, or were fading, revealed the presence of this weevil. The mature insect was never to be seen above the ground during the day-time, but under cover of darkness it did considerable damage to the fronds; while the larvae, boring through the rhizomes and leaf-stalks, hollowed out the centre, eventually killing the plant. Mr. C. O. Waterhouse, (1) of the British Museum, described the weevil as a new species belonging to the Australian genus *Syagrius*. Prof. G. H. Carpenter (2) subsequently published a report of its occurrence, together with an account of the steps taken to exterminate it. I am indebted to Mr. F. W. Moore for giving me every facility for observing and procuring specimens of the insect.

Habits.

The eggs of the weevil are deposited singly in a deep pit, which is indicated externally by a small round puncture on the leaf-stalk or on the rhizome. I have been unable to determine the period of hatching. The soft, white grubs, spend all their life burrowing through the larger portions of the stems, and even in the hardest parts of the rhizome, and are found rather sparely on specimens that have been attacked. One or two grubs, I have noticed, are able to execute a good deal of

[1] Read before the Association of Economic Biologists, Edinburgh Meeting, July 29th, 1908.

damage, the duration of the larval period being probably rather prolonged, as specimens kept under observation for some weeks showed no appreciable growth. The pupae, which are capable of rather active movements if disturbed, are found in the hollowed-out portions of rhizome and stalk-base, and in the intermingled debris. The mature weevil is nocturnal in habit, remaining in the soil during the hours of daylight. It attacks the green portion of the plants, being most destructive to the young fronds, though if it be offered nothing better it will certainly nibble at the harder parts, which it does perhaps during its sojourn below ground. The ravages of this species appear to be strictly confined to hot-house ferns, and although a majority of the genera in the fern-houses have at some time or another been subjected to attack, yet the species of *Davallia*, *Adiantum*, *Todea*, and *Nephrolepis* have endured by far the greatest devastations. *Lastrea*, *Nephridium*, *Polypodium*, and *Asplenium* are also genera which have suffered severely.

Remedies.

With a view to exterminating the insect, fumigating with tobacco was at first tried, but without effect; watering with a solution of Potassium Cyanide, and then washing out with fresh water, was successful in killing the grub only when the solution was of sufficient strength to kill the plant as well. A number of weevils, grubs, and pupae were destroyed by the laborious process of picking the roots clean of all soil, but this was very severe upon the plants. Eventually the houses were fumigated once a month during the night-time, with hydrocyanic acid, likewise an ineffectual method. The plan of steeping the plants in water was then tried, the top of the pot being placed well under the surface; after fifteen minutes of such immersion, all the weevils present in the soil are found to have taken refuge in the stems, where they can be picked off by hand and destroyed. This was found to be the most successful method of dealing with them, and after a year or two a very considerable reduction in the numbers of the insects was effected. Occasional steepings have since then served to keep them in check, and have further diminished their numbers.

Allied Forms Attacking Ferns.

The genus *Syagrius* was defined by Pascoe (3), the type before him being the Australian species *S. fulvitarsis*, from the Richmond River. He regarded it as being allied to the rare genus *Steremnius*

and referred it to the Molytides. Mr. W. W. Froggatt (4) records the appearance of this *S. fulvitarsis* from greenhouses at Sydney, where it damages the leaf-stalks of *Calipteris prolifera*, its habits being apparently similar to those of *S. intrudens*. Mr. Froggatt, however, in the same paper (4) describes a very much more destructive pest, which he terms the Maiden-hair Fern Weevil, publishing, together with his account, Mr. A. M. Lea's description of that species. Mr. Lea is of opinion that it belongs to a genus allied to, but distinct from, *Syagrius*, and terms it *Neosyagrius cordipennis*. This species is remarkably small, a circumstance which enables its grub, which, when full-grown, is only $1\frac{1}{2}$ lines in length, to spend its life eating its way down the delicate leaf-stalks of the Maiden-hair Fern. The tiny Weevil, with short, heart-shaped body, spends the day-time concealed in the earth; during the night-time, it eats the fronds and deposits its eggs on the stems.

As the result of a number of experiments it was found that the best remedy was to place the ferns under water, the beetles being collected and destroyed as they came to the surface. Half an hour is sufficient to drive out the Weevils, but it appears that the ferns improve by being left over-night in lukewarm water, as not only are all the beetles driven out of the soil, but the larvae and pupae are smothered by the water which penetrates into the damaged fronds. If care is taken not to startle them by sudden light or movements, numbers may be taken by shaking the plants over paper during the night time.

In view of the habitat of the above species it seems probable that *Syagrius intrudens* has been introduced into the Botanic Gardens at Dublin from Australia, and it is more than likely that this species or related forms, will at some time claim the attention of fern cultivators elsewhere. Hence the advisability, in most cases, of subjecting newly-acquired plants to a strict quarantine, and of immersing the pots to detect the presence of the Weevil.

It may be mentioned that the grubs and imago of the native genus, *Otiorrhynchus*, are at times found together with those of *S. intrudens*, but the grubs of the latter are readily distinguished by being whiter, and having few hairs upon the body, and a more globular head.

Before proceeding to the details of the larva and pupa, I may remark that very few Weevil larvae appear to have been adequately figured and described. E. Perris (5), in his "Larves de Coléoptères," described in detail, as a Curculionid type, both larva and pupa of *Balaninus elephas*; the description, unfortunately, is not illustrated. The most complete account of a Weevil larva and pupa that I am acquainted with, is that of *Balanogastris kolae* by M. P. Lesne (6).

He lays particular stress upon the distribution of the sensory hairs of the larva and the "styli motorii" of the pupa.

Structural Details.

Egg (Pl. vi, fig. 1).—Length, 1.4 mm., smooth, opaque white, cylindrical, with sides parallel, one end more obtusely rounded than the other, twice as long as broad.

Larva (Pl. vi, figs. 2-8).—Body a pure white, with yellow-brown head, legless, skin wrinkled, rather elongate, length of largest larvae about 12 mm. when moderately extended. The head is of medium size, strongly chitinised, and decidedly globular. The frons (*f*, fig. 3) carries six characteristically situated sensory hairs, the epicranium about ten (*ep*, fig 3). The sutures (fig. 3) are markedly different from those of *Balaninus elephas* (5) and *Balanogastris kolae* (6), the apex of the frons being very obtuse, and the suture between it and the epicranial plate is on each side, at a little distance from the apex, continued on for some distance (*lat*, fig. 3) parallel to the median epicranial suture. The antennae (*a*, fig. 4) are minute, and can be made out just above and between the ginglymus (*g*, fig. 4) and the insertion of the flexor of the mandible (*in*, fig. 4) there are not more than two segments apparent. Just above and to the outside of the antenna, on each side there is a small darkly pigmented ocellus (*o*, fig. 4). Antennae and eye-spots are similar in *Balaninus elephas* and *Balanogastris kolae*, but according to Lesne the proximal segment of antenna is only the articular membrane. The clypeus (*c*, figs. 3, 4) is distinctly articulated with the frons, and is rectangular, tapering slightly. It is small, overlaying a portion of the mandibles, and bearing no setae. In *Balanogastris kolae* the clypeus bears three pairs of sensory hairs. The labrum (side view *l*, fig. 4) is about twice as broad as long, and is rounded off distally. The anterior surface bears six sensory hairs, and the edge is furnished with ten short bristles, the two central of which are the stoutest.

The dark-coloured mandibles (figs. 4, 6) are very strong, tetrahedral in shape, and have the condyle (*co*), ginglymus (*g*), and area of insertion of the extensor muscle (*in*) prominently developed. The apex of each mandible is divided into two short teeth, and the anterior surface bears a single hair. The tendon of insertion of the flexor muscle (*fl*) is very broad, and lies in an antero-posterior plane. The maxillae (figs. 5, 7) are free from the head skeleton, and are about a third longer than the mandible. Each possesses a chitinized cardo (*cr*) and stipes (*st*), the latter bearing three delicate setae. The lacinia (*la*) is a simple process bearing at its apex and along the edge about fifteen short,

strong hairs. The palp (*pl*) is represented by a two-segmented process, which is just a little longer than the lacinia. The labium (figs. 5, 8) is clearly posterior to the maxillae, its basal portions overlapping those parts. The supporting gular region (*gl*, fig. 5) consists of soft fleshy lobes, which carry some half-a-dozen delicate hairs, and converge somewhat acutely to the apex of the labium, which is encircled by a pale brown, chitinized, cuticular band (*x*). Beyond this plate (*x*) the extremity carries a pair of two-segmented papillae (*lp*), no doubt the labial palps. On the posterior aspect of the tip, slightly internal to the palps, are a proximal pair of fine hairs and a distal pair of shorter stouter ones.

The more important folds of the cylindrical body show (fig. 2) more particularly on the ventral region, that there are twelve body segments represented. The folds of the individual segments do not appear to be so definite as those described by Lesne. The larvae is legless. The lowest of the lateral folds being, perhaps, to some extent, of service as pro-legs ; in the abdominal regions these folds carry two, and in the thoracic region a few more, setae. More decided vestiges of the legs appear to exist in *Balanogastris kolae.* There is a decided pronotal plate (*pr*), which is lightly tinted with brown ; it carries a couple of hairs. The general surface of the body is furnished with a very few small, scattered setae ; however, segments eleven and twelve each carry some half-a-dozen characteristically placed elongate hairs. "Spinules tégumentaires," such as are described in *Balanogastris kolae*, are absent from the integument. Spiracles, which are marked by a faint brownness of the cuticle, are present upon the first thoracic and on the first eight abdominal segments.

Pupa (Pl. vii, figs. 1-2).—Length variable, averaging 6 mm. in examples met with. White. Surface conspicuously spiny, with numerous short setae, each borne upon a soft conical papilla ; these, termed "styli motorii," by Lesne, are most probably locomotive in function. The head is smooth, with the exception of seven pairs of setiferous papillae, which are situated at intervals, on each side of the middle line, along the forehead (*fr*) and rostrum (*r*). The proportions of the antenna are somewhat different from those of mature insect, the scape being relatively very much shorter, and coming off from the middle of the rostrum. The prothorax (*p*) carries two pairs of centrally situated setae ; seven or eight of smaller size extending over the lateral surface on each side. The mesothorax (*m*) bears across its dorsal surface some half-dozen setae. The elytra arise laterally, taper to a point, and have their surface marked by ten or so longitudinal grooves. The elytra are embraced between the second and third thoracic legs of

each side. At the femoro-tibial articulation, there are on each of the legs a pair of setae. The metathoracic segment is indicated by a slight setiferous prominence, the abdominal segments being more decidedly ridged off. The first seven of these latter segments bear dorsally situated rows of eight, or at most ten, setae; the eighth carries but two. In *Balanogastris kolae* the hairs are everywhere distributed in accordance with the same plan, but are fewer in number. The anal segment (not regarded as separate segment by Lesne) has a pair of small posteriorly directed processes (*ap*), which are each furnished with three minute hairs and terminated by a single, curved, chitinous bristle. A pair of similar processes are present in *Balaninus elephas* and *Balanogastris kolae*. The spiracles which I have observed are:—A pair on the metathorax anterior to the very small wing rudiments, and a pair upon each of the eight succeeding segments, in front of and slightly below the most laterally situated of the dorsal setae.

Imago (Pl. vii, figs. 3, 4, 5).—To accompany the figures of the adult Weevil, I append below Mr. F. P. Pascoe's (3) definition of the genus, and Mr. C. O. Waterhouse's (1) diagnosis of this species. I may add, that the short, light-brown pubescence, very conspicuous on actual specimens, does not appear so distinctly in figures 3 and 4. On removing the elytra the dorsal abdominal tergites are seen to be exceptionally soft, the wings appearing as minute scales. In some specimens I found the elytra were united, in others free.

Genus Syagrius, Pascoe.

"*Rostrum* modice elongatum, arcuatum; *scrobes* praemedianae, obliquae, infra rostrum currentes. *Oculi* ovales, grosse granulati. *Scapus* oculum haud attingens; *funiculus*, 7-articulatus articulis extus gradatim crassioribus. *Prothorax* lateribus rotundatus, basi rectus; lobis ocularibus nullis. *Scutellum* invisum. *Elytra* cylindrica, prothorace haud latiora. *Coxae* posticae rotundatae; *femora* mutica, antica majora; *tibiae* flexuosae, muticae; *tarsi* breves, latiusculi; *unguiculi* liberi. *Abdomen* segmentis duobus basalibus ampliatis, sutura prima distincta."

Syagrius Intrudens, Waterhouse.

"Elongatus, crassus, subparallelus, piceo-niger, parum nitidus, rugosus; antennis tarsique piceis. Long. 7-10 mm.

"Rostrum gently arcuate, thick, with a fine median smooth line, and with a groove on each side above the antennal groove; the apex shining and finely punctured. Forehead rugosely punctured, with a well-marked impression in the middle. Thorax with its broadest part

in front of the middle, a trifle narrower at the anterior angles than at the posterior; the sides arcuate; the base exactly fitting the base of the elytra, but a trifle narrower. The surface very uneven, consisting of closely packed irregular obtuse tubercles, some of which are shining. The interspaces with very short brownish pubescence. Elytra very convex, humped up at the suture, with a slight constriction at the base, gradually widening from this to the apical declivity, where they are as wide as the widest part of tht thorax. Apical declivity almost vertical. The region of the scutellum and some irregular, rather oblique, vermiculate impressions dull black. The rest of the surface covered with very irregular more or less confluent tubercles, which are themselves ornamented with very small shining tubercles. Near the suture, just at the apical declivity, there are two tubercles, which are rather more prominent than the others; these and some of the others have more or less brownish hair on them. There are also some of these short brown hairs just within the humeral angle. At the sides there are two or three rows of elongate deep foveae.

"The punctuation of the basal portion of the rostrum varies very much. Some specimens have it closely and rugosely punctured; in others the punctures are separated and the surface is shining. This difference is no doubt sexual. This species resembles *S. fulvitarsis*, Pascoe, but the rostrum is less strongly curved, and the tubercles on the dorsal surface of the thorax and elytra are much more numerous. In *S. fulvitarsis* the dull black surface is greater than that occupied by the tubercles; in *S. intrudens* the reverse is the case."

REFERENCES.

1. **Waterhouse, C. O.**—Description of a new Coleopterous Insect belonging to the Curculionidae. Ann. Mag. Nat. Hist., 1903 (7), vol. xi.

2. **Carpenter, G. H.**—Injurious Insects observed in Ireland during the year 1902. Econ. Proc. R. Dub. Soc., 1903. Vol. i, p. 204.

3. **Pascoe, F. P.**—Additions to the Australian Curculionidae. Ann. Mag. Nat. Hist., 1875 (4), vol. xvi.

4. **Froggatt, W. W.**—Some Fern and Orchid Pests. Agric. Gazette N.S. Wales, 1904, vol. xv, part 6, p. 516.

5. **Perris, E.**—Larves de Coléoptères. Ann. Soc. Linn. d. Lyon, 1877. (n.s.), xxiii, pp. 207-251.

6. **Lesne, P.**—Description de la Larve et de la Nymphe du Charançon de la Noix de Kola. Bull. Mus. Hist. Nat. Paris, 1898, iv, pp. 140-147.

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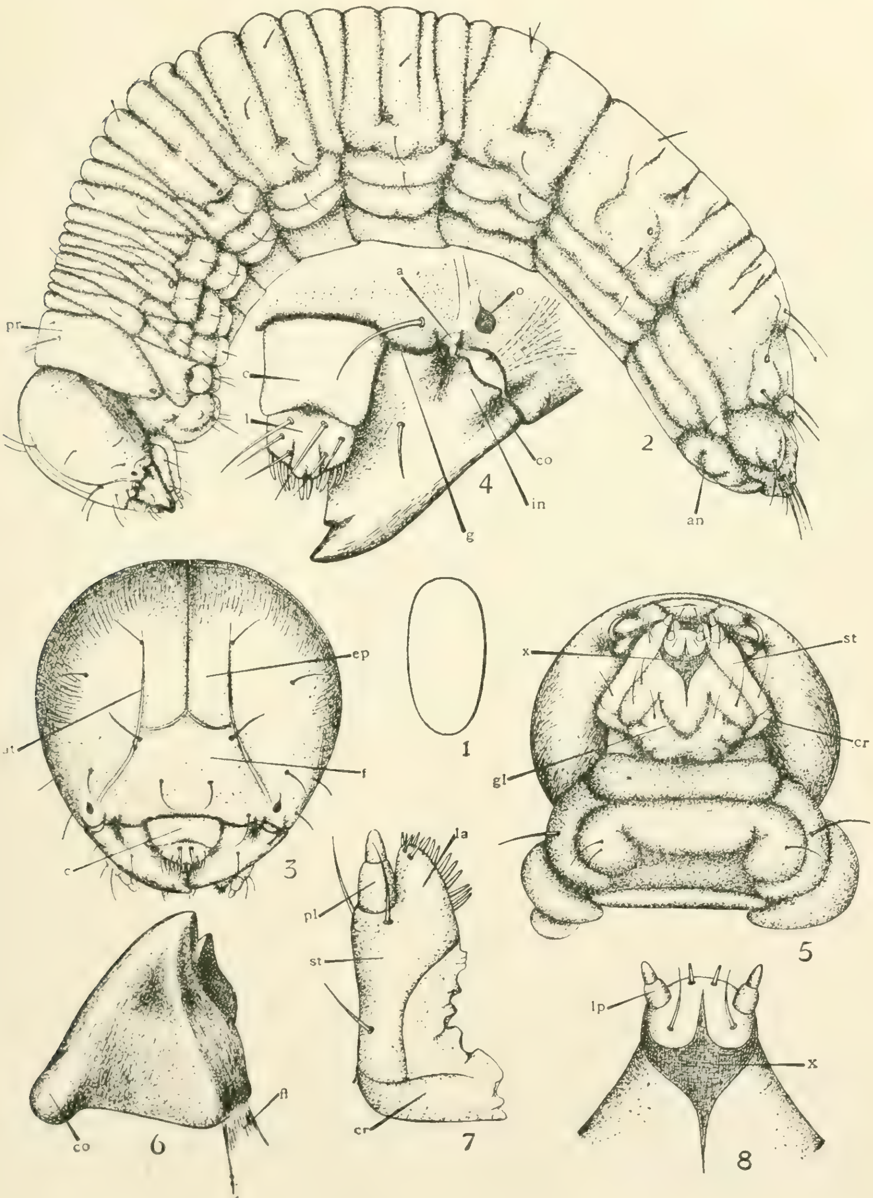
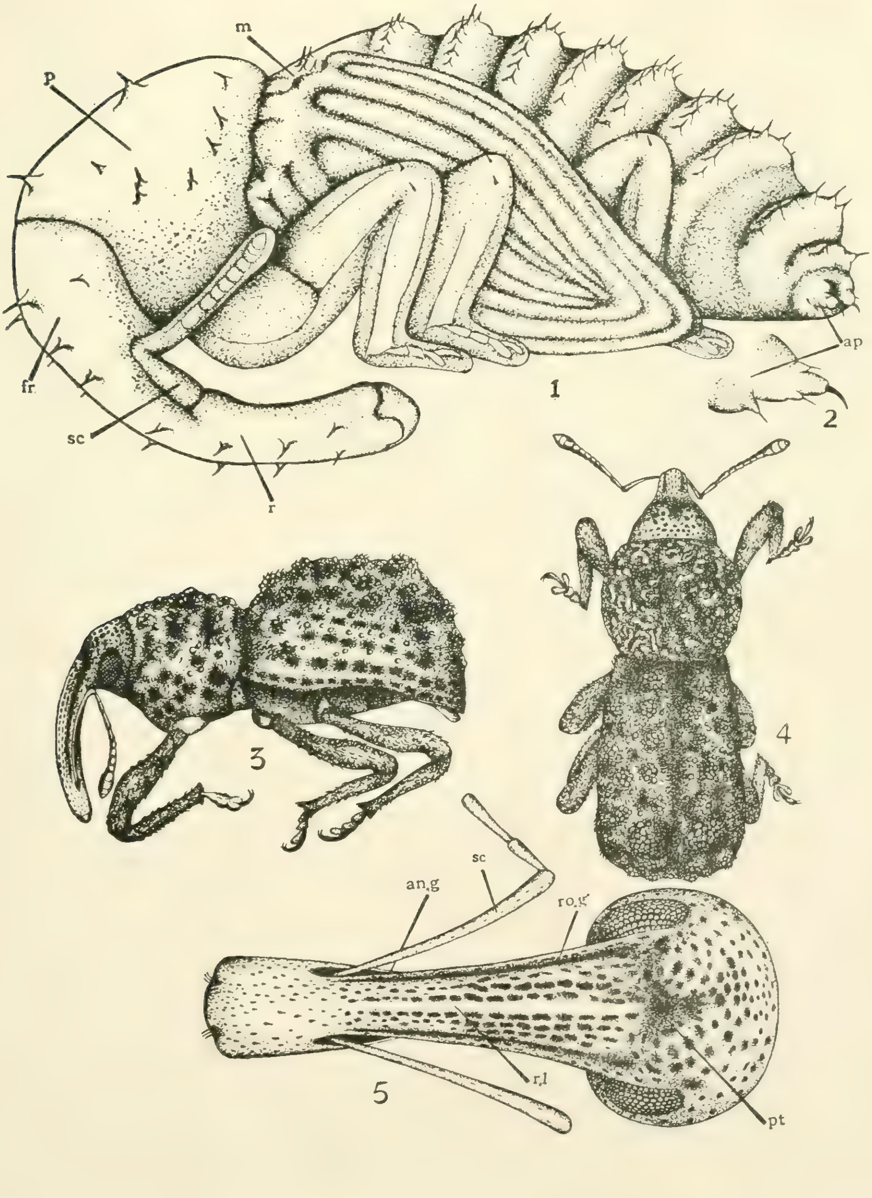


SYAGRIUS INTRUDENS, Waterh.



SYAGRIUS INTRUDENS, Waterh.

DESCRIPTION OF PLATES VI AND VII.

Illustrating Mr. Joseph Mangan's paper on "The Life-History of *Syagrius intrudens*," Waterh.

Plate VI.

Fig. 1.—Egg of *Syagrius intrudens*. × 15.
Fig. 2.—Larva of *S. intrudens* viewed from the side. × 19.
Fig. 3. Head of same viewed from in front. × 33.
Fig. 4.—Labrum and mandible viewed rather laterally: also showing the left antenna and ocellus. × 78.
Fig. 5.—Head and mouth-parts viewed from below, with the head pressed slightly upwards. × 33.
Fig. 6.—Right mandible viewed from behind. × 78.
Fig. 7.—Right maxilla do. do.
Fig. 8.—Labium do. do.

a, antenna; *an*, anus; *c*, clypeus; *co*, condyle; *cr*, cardo; *ep*, epicranium; *f*, frons; *fl*, tendon of insertion of flexor muscle of the mandible; *g*, ginglymus; *gl*, gular lobes; *in*, insertion of extensor muscle of the mandible; *l*, labrum; *la*, lacinia; *lat*, lateral continuation of epicranial suture; *lp*, labial palp; *o*, ocellus or eye spot; *pl*, maxillary palp; *pr*, pronotal plate; *st*, stipes; *x*, sclerite on posterior surface of labium.

Plate VII.

Fig. 1.—Pupa of *S. intrudens* viewed from the side. × 21.
Fig. 2.—Left process of anal segment of pupa. × 53.
Fig. 3.—Imago of *S. intrudens* viewed from the side. × 8.
Fig. 4.—Dorsal view of same. × 8.
Fig. 5.—Head and rostrum of same viewed from in front. × 21.

an.g, antennal groove; *ap*, process of anal segment; *fr*, forehead; *m*, mesothorax; *p*, prothorax; *pt*, pit-like depression on forehead; *r*, rostrum of pupa; *n.l*, smooth median line on rostrum; *ro.g*, superior rostral groove; *sc*, scape of antenna.

REVIEWS.

Connold, E. T.—British Oak Galls. Pp. xviii + 169, 68 plts. and 17 text figs. London: Adlard & Son, 1908. Price net.

There is so much excellent foreign literature upon Galls and Gall-makers that we opened Mr. Connold's book with great expectations, only to have our hopes disappointed. At times we have had occasion to refer to the beautifully illustrated and lucidly written works of Keiffer, Houard, Trotter, Giraud, Perez, and other Continental writers, and possibly after the excellent descriptions that are to be found in such works, we came expecting too much. However, the fact remains, that the information given in this book, like that in the author's previous one on "British Vegetable Galls," is of the scantiest.

There is an abundant literature on Oak Galls and their inhabitants, and we are sorry that the author has not made greater use of the same.

The half-tone illustrations are all excellent, indeed quite equal to any we have seen of galls, and the objects have been selected with care and discrimination. Such an admirable series of figures go a long way to redeem many shortcomings in this book, and will be a source of help to all who are interested in British Oak Galls.

W. E. C.

Darwin, Charles.—Insectivorous Plants. Revised by Francis Darwin. Pp. xiv + 377, 30 illustrations. London: John Murray, 1908. Price 2s. 6d. net.

The issue of a popular edition of Darwin's fascinating work on Insectivorous Plants will be welcomed by a large body of naturalists, whilst it places within the reach of the rising generation all but one of Darwin's great works published by Mr. John Murray.

Since it was first published, now thirty-three years ago, much valuable work has been done; great strides have been made in the study of vegetable physiology, and experimental botany, but, as with all the author's works, time does not lesson their interest.

All who take an interest in plant life will read the book with a keen appetite, whilst to naturalists generally its perusal is still a part of their education.

At a time when Natural History Societies are stocking their book-shelves with much illustrated literature of an ephemeral nature, we would strongly advise the addition of the Popular edition of Darwin's works, which Mr. Murray has placed before the public in such an admirable style.

W. E. C.

Fisher, W. P.—Forest Utilization. Vol. V. Schlich's Manual of Forestry. Second Edition. Pp. xxii + 840, 5 plts. and 402 text figs. London: Bradbury, Agnew & Co., Ltd., 1908. Price 12s. net.

All students of forestry will welcome the second edition of Professor Fisher's valuable work on Forest Utilization. Since its publication in 1896, it has been regarded by all competent authorities as the leading and most comprehensive work on the subject.

Founded upon a translation of Gayer's "Die Forstbenutzung," which like most great works had become such whilst passing through a series of editions, nine in all, dating from 1863 to 1903, the author has made numerous additions in the form of notes, and has generally brought the subject up-to-date, so that it now remains the standard work in the English language on this important subject, and cannot fail but prove of great use and value to all students and practical foresters.

With the renewed interest which is now being taken in forestry in this country, we can only hope that the second edition will be even more successful than the first, of which 1,500 copies were issued in 1896.

W. E. C.

Janet, Charles.—Anatomie du Corselet et Histolyse des Muscles Vibrateurs, apres le Vol Nuptial chez la Reine de la Fourmi *Lasius niger*. Pp. 149 + 20, 13 plts. and 45 text figs. Limoges: Ducourtieux et Gout., 1908.

Of all the memoirs of M. Janet's great work "Études sur les Fourmis, les Guêpes et les Abeilles," of which this is the twenty-sixth, none are more beautifully produced or greater in interest.

Like all this author's work, it is as near perfection as unwearied and patient research can make it, indeed it is not too much to say that amongst the many magnificent works on insects—systematic and anatomical—it is not surpassed for accuracy of detail and faithful minutiae.

The work lends itself to a division into two parts, the first treating of the pairing, nest founding and nuptial flight; and the second and major portion of the work of the histolysis of the flight-muscles and the detailed structure of the thoracic exoskeleton.

The degeneration of the great flight-muscles, functional during the life of the queen-ant for only a few hours, the enrichment of the vascular system by their broken down constituents, and the consequent supply of food necessary for the production of a large number of eggs and the nourishment of the larvae, is described in great histological detail with a full appreciation of its vast physiological import.

No student of insect anatomy or insect bionomics can afford to overlook this magnificent work, which is characterised by wonderful detail and accuracy, beautiful illustrations, and a lucidity to be envied.

W. E. C.

Johnstone, James.—Conditions of Life in the Sea. Pp. xiv + 332, 1 plt. and 31 figs. Cambridge: The University Press, 1908. Price 9s. net.

There is at present no adequate summary in English, the author informs us, of the main results of modern quantitative marine biological investigations, we therefore welcome Mr. Johnstone's work as an admirable and valuable piece of work.

The book is divided into three parts, the first supplying a general account of the main facts of oceanography; part ii. deals with the methods and results of quantitative marine biological research; and part iii. with the general conditions of life in the sea.

To condense into three hundred pages an account of these three sections is no easy task, much of the matter upon which they are founded is of a highly technical nature, and such as requires the most careful discrimination, and admittedly imperfect and incomplete as are the investigations, a fact freely admitted by the author, they nevertheless have been handled with such skill as to form a most fascinating whole.

The distribution of the plankton, the productivity of the sea, the conditions of life and the bacteria of the sea, are chapters specially commendable, and full of thoughtful work that must appeal to all who take an intelligent interest in modern biological development.

Mr. Johnstone has been at some pains to bring the information now given up-to-date, whilst a short bibliography, together with numerous references in foot-notes, will enable the reader to at once tap the original sources of information.

Enough has been said to show that this is a work of considerable interest, and cannot fail to appeal to a large number of readers.

W. E. C.

Pearson, J.—L. M. B. C. Memoirs. XVI. Cancer. Pp. viii + 209. Plts. i-xiii and 12 figs. London: Williams & Norgate, 1908. Price 6s. 6d.

The subject of this memoir, *Cancer pagurus,* the edible crab of this country, is an animal of great economic importance and zoological interest.

So far as the morphology is concerned the author has given an excellent account of both the external and internal structure, but we should have welcomed more fuller details under the section Economics and Bionomics.

Why the figures illustrating this valuable series of memoirs should be reproduced in a sooty-coloured ink instead of a deep black, and on tinted instead of white paper, is a mystery unknown to us, but whatever the cause it greatly depreciates their value.

W. E. C.

Poulton, E. B.—Essays on Evolution, 1889-1907. Pp. xlviii + 480, 1 plt. and 7 text figs. Oxford : The Clarendon Press, 1908. Price 12s. net.

The eleven essays included in this volume deal mainly with the subject of mimicry, to the literature of which they are a valuable addition.

The introduction will be read with considerable interest, for Professor Poulton enters a strongly worded protest against the narrowness and prejudice apparent in the earlier works of Bateson on Variation, and has some equally pertinent remarks on the "grotesque exaggeration" of other Mendelians. He contends that the conclusions supported in the present volume are inconsistent with a theory of evolution by Mutation, inconsistent with the views often expressed by Mendelians, but not inconsistent with the discoveries of Mendel himself.

Excepting the first, the Introduction, and the seventh essay, all have been published some time, but the author has revised and modified them since, and made many additions to the text and footnotes.

In much that Professor Poulton regards as Mimicry we are unable to follow him, but most biologists will welcome his trenchant criticism of Mendelism.

It has been evident for some time past that there was gradually creeping into Mendelian literature an "amount of dogmatism concerning work which the writer was evidently imperfectly acquainted" with, and that assumptions were being made on the slenderest evidence. Professor Poulton thinks that the Mendelian "is to some extent paralysed by his own work," but whether this be so or not, it is no excuse for appropriating under the name of Mendel the results of Weissman, or the contemptuous depreciation of the work of others.

The author strikes boldly, but fairly throughout, and we welcome his outspoken defence and criticism.

The work concludes with a most useful and carefully compiled analytical index, extending over eighty printed pages.

W. E. C.

Shipley, A. E.—Pearls and Parasites. Pp. xv + 232, 10 illustrations. London : John Murray, 1908. Price 7s. 6d.

Since Huxley published his justly popular "Essays and Addresses," there have been few scientific essayists who have commanded more than passing attention. Some are curt and uninteresting, others verbose and wearisome.

The author of the interesting volume before us seems to have hit the happy medium, and whether writing on "British Sea-Fisheries," "Malaria," or of the claims of the University of and in which he is so distinguished an ornament and worker, there is the same graceful charm and lucidity, full of freshness and keen interest.

Most of the nine essays we have had the pleasure of reading before, but in perusing them for a second time they have lost none of their original interest, and we welcome them in book form for future reference.

Few men are more competent than Mr. Shipley to pronounce an opinion on such subjects as our sea-fisheries, malaria, parasitic diseases due to flies, pearl fisheries, and the financial needs of Cambridge University, and all who are interested, even in the slightest degree, in these subjects, will read this work with both pleasure and profit.

W. E. C.

Thomson, J. Arthur.—Heredity. Pp. xvi + 605, 49 illustrations. London: John Murray, 1908. Price 9s. net.

Amidst the voluminous, and often very dogmatic, literature dealing with the important subject of Heredity, it is refreshing to find a calm, tolerant, lucid, and comprehensive work like the one before us. It is not too much to say that the most outstanding feature is the fair and kindly manner in which all views are presented.

We have just stated that the work is lucid and comprehensive, and on this account alone far surpasses any book we know of for the beginner, or he would have marshalled before him the facts and fancies upon which our ideas of heredity are founded.

Whilst there are many controversial matters on which we strongly differ from Prof. Thomson's view, we put these aside for the present, in acknowledgment of the admirable survey he has given us of a most complicated subject in a manner uncommon to works on such subjects.

If the book has a fault, it is the insufficient critical spirit, but when one reflects that two-thirds of the so-called scientific criticism of the present day is such childish and puerile fault finding, we are glad to find only such criticism as "is the ripe fruit of combined intellectual insight and long experience," and not the petty jealousies unworthy of seekers after truth.

The book is beautifully illustrated, contains an excellent bibliography and subject index to the same, and a full index.

W. E. C.

CURRENT LITERATURE.

I.—General Subject.

Burgess, A. F.—Description of new devices for rearing Insects. Journ. Econ. Entom., 1908, vol. i, pp. 267-269, plts. 3, 4.

II.—Anatomy, Physiology, and Development.

Gahan, C. J.—On the Larvae of *Trictenotoma childreni*, Gray, *Melittomma insulare,* Fairmaire, and *Dascillus cervinus,* Linn. Trans. Entom. Soc. Lond., 1908, pp. 275-282, plt. vi.

Imms, A. D.—On the Larval and Pupal Stages of *Anopheles maculipennis,* Meigen. Parasitology, 1908, vol. i, pp. 103-133, plts. ix, x.

Paoli, G.—Intorno all'organo del Graber nelle larve di Ditteri Tabanidi. Redia, 1907, vol. iv, pp. 247-258, 6 figs.

Vickery, R. A.—A Comparative Study of the external anatomy of Plant Lice. 12th Rpt. State Entom. St. Anthony Park, Minn., 1908, pp. 1-16, 5 figs.

Wesché, W.—Notes on the value of the genitalia of insects as guides in Phylogeny. Trans. Entom. Soc. Lond., 1908, pp. 297-305.

III.—General and Systematic Biology, and Geographical Distribution.

Berlese, Antonio.—Considerazioni sui rapporti tra piante, loro insetti nemici e cause nemiche di queste. Redia, 1907, vol. iv, pp. 198-246.

Berlese, Antonio.—Istruzioni pratiche per coloro che vogliono rinnovare le esperienze do lotta contro la mosca delle olive col metodo dachicida. Ibid., pp. 193-197.

Berlese, A., Del Guercio, G., Paoli, G.—Osservazioni sopra un recente scritto relativo ad insetti nocivi all'Olivo. Ibid., pp. 259-328.

Börner, C.—Eine monografische Studie über die Chermiden. Arb. Biol. Anstalt f. Land-u. Forstw., Berlin, 1908, Bd. vi, Heft. 2, pp. 239, 3 tav. e 101 fign.

Buffa, P.—Alcune notizie anatomiche sui Tisanotteri Tubuliferi. Redia, 1907, vol. iv, pp. 369-381, 17 figs.

Buffa, P.—Esame della Raccolta di Tisanotteri italiani esistente nel Museo Civico di Storia Naturale di Genova. Redia, 1907, vol. iv, pp. 382-391, 5 figs.

Carpenter, Geo. H.—On Two Collembola new to the Britannic Fauna. Irish Nat., 1908, vol. xvii, pp. 174-179, 8 figs.

The two new forms are *Isotoma tenella,* Reuter, and *Agrenia bidenticulata* (Tulb.) var. nov. *elongata.*

Cockerell, T. D. A.—Fossil *Cercopidae* (Homoptera). Bull. Winconsin Nat. Hist. Soc., 1908, vol. vi, pp. 35-38.

Cooper, W. F., and Robinson, L. E.—On six new species of *Ixodidae,* including a second species of the new genus *Rhipicentor,* N. & W. Proc. Camb. Phil. Soc., 1907, vol. xiv, pp. 457-470, 24 figs.

Fuschini, C.—Contributo allo studio della *Philloxera quercus,* Boyer. Redia, 1907, vol. iv, pp. 360-368.

Green, E. E.—Remarks on Indian Scale Insects (Coccidae) Pt. III. Mem. Dept. Agric. India, Entom. Ser., 1908, vol. ii, no. 2, pp. 15-46, plts. ii-iv.

Describes 1 new genus, 18 new species, and 1 new variety. There is a useful Catalogue of Indian Coccidae of 102 species.

Lebour, Marie V.—Fish Trematodes of the Northumberland Coast. Northumberland Sea Fisheries Comm. Rpt. for 1907, 1908, pp. 23-67, plts. i-v.

An important contribution to the subject. One genus and six species are described as new.

Marlatt, C. L.—New species of Diaspine Scale Insects. Ibid., Tech. Ser. No. 16, pt. ii, pp. 11-32, plts. i-ix.

The author describes 17 new species, four of which are apparently native to the American Continent, and the remainder foreign. All are of potential economic importance, as indicated by the place of origin and the host plants.

It is most unfortunate that none of the species are figured, beyond some very indistinct figures from photo-micrographs of the anal plates.

Newell, W.—Two interesting Inquilines occurring in the nests of the Argentine Ant. Journ. Econ. Entom., 1908, vol. i, pp. 262-265.

Nuttall, G. H. F., and Warburton, C.—On a new genus of *Ixodoidea,* together with a description of eleven new species of ticks. Proc. Camb. Phil. Soc., 1907, vol. xiv, pp. 392-416, 45 figs.

Nuttall, G. H. F., Cooper, W. F., and Robinson, L. E.—The Structure and Biology of *Haemaphysalis punctata*, Canestrini and Fanzago. I. Parasitology, 1908, vol. i, pp. 152-181, plts. xii-xvi, and 9 text figs.

Ribaga, C.—Di una peculiare alterazione delle foglie di Gelso dovuta ad un Omottero. Redia, 1907, vol. iv, pp. 329-333, T.v.

Sanderson, E. D.—The Influence of Minimum Temperatures in limiting the Northern Distribution of Insects. Journ. Econ. Entom., 1908, vol. i, pp. 245-262, 7 maps.

Shipley, A. E.—Note on *Cystidicola farionis*, Fischer. A Thread-worm parasitic in the Swim-bladder of a trout. Parisitology, 1908, vol. i, pp. 190-192.

III.—Agriculture and Horticulture.

Ballou, E. A.—Cacao Thrips. W.I. Bull, 1908, vol. ix, pp. 190-192, 2 figs.

Carpenter, Geo. H.—Injurious Insects and other Animals observed in Ireland during the year 1907. Econ. Proc. Roy. Dublin Soc., 1908, vol. i, pp. 559-588, plts. xlix-liv, and 10 text figs.

Chittenden, F. H.—The Asparagus Beetles. U.S. Dept. Agric., Bur. of Entom., Circ. No. 102, 1908, pp. 1-12, figs. 1-6.

Chittenden, F. H.—The Harlequin Cabbage Bug. (*Murgantia histrionica,* Hahn.). U.S. Dept. Agric., Bur. of Entom., Circ. No. 103, 1908, pp. 1-10, 1 fig.

Chittenden, F. J.—Apple Leaf Spot. Journ. Roy. Hort. Soc., 1908, vol. xxxiii, pt. ii, pp. 500-511, figs. 89-91.

Chittenden, F. J.—A Disease of the Cineraria. Journ. Roy. Hort. Soc., 1908, vol. xxxiii, pt. ii, pp. 511-513, figs. 92, 93.

Collinge, Walter E.—The Possibility and Danger of the Introduction of the San José scale into Great Britain. Proc. Assoc. Econ. Biol., 1908, vol. i, pp. 171-178.

Coudon, F. D.—A Gall-Maker of the Family *Agromyzidae*. (*Agromyza tiliae,* n.sp.). Proc. Entom. Soc. Washington, 1908, vol. ix, pp. 1-4, 1 fig.

Del Guercio, G.—Notizie intorno a due nemici nuovi e ad un noto nemico dell 'olivo mal conoscinto, con un cenno sui rapporti di uno di essi con i microsporidi. Redia, 1907, vol. iv, pp. 334-359, 14 figs.

Evans, I. B. P.—Potato Scab. *Oospora scabies*, Thaxter. Transv. Agric. Journ., 1908, vol. vi, p. 576, plt. 77.

Evans, I. B. P.—Anthracnose or Zwart Roest of the Grape. (*Gloeosporium ampelophagum*, Sacc.). Ibid., pp. 577-580, plts. 78-80.

Felt, E. P.—Notes on the Work against the Gypsy Moth. Journ. Econ. Entom., 1908, vol. i, pp. 275, 276.

Fernald, H. T.—The Fundamental Principles of Spraying. Journ. Econ. Entom., 1908, vol. i, pp. 265-267.

Gunning, J. W.—Locusts Birds. Transv. Agric. Journ., 1908, vol. vi, pp. 527-530.

Güssow, H. T.—The Predisposition of Plants to Parasitic Diseases. Proc. Assoc. Econ. Biol., 1908, vol. i, pp. 158-170.

Henderson, L. F.—Spraying Experiments for 1907. Univ. Idaho Agric. Exp. Stat., Bull. No. 61, 1908, pp. 1-15.

Hinds, W. E.—The First and Last essential step in combating the Boll Weevil. Journ. Econ. Entom., 1908, vol. i, pp. 233-243.

The author states in conclusion—"The question here presented is a vital one for the weevil infected area. It demands not merely acquiescence, but action. The accuracy of the facts presented cannot be questioned, but each man must decide for himself as to the correctness of the conclusions. To us it appears that this statement does abundantly justify the broad, general conclusion that the destruction of stalks by some effective method and as long as may be possible before the normal time for weevils to enter hibernation constitutes the most effective method now known of reducing the severity of the weevil attack upon the following crop, and that it therefore deserves general recognition and adoption as the last step in the treatment of each season's crop, and essentially the first step also in the production of a crop with the minimum weevil injury during the following season."

Hooper, C. H.—The Commoner Birds of our Gardens: their Habits and Foods. Journ. Roy. Hort. Soc., 1908, vol. xxxiii, pt. ii, pp. 427-450.

Howard, C. W.—The Codling Moth. Transv. Agric. Journ., 1908, vol. vi, pp. 523-526, plt. 62.

Howard, C. W.—Notes on Transvaal Tobacco Pests. Ibid., pp. 609-616, plts. 81, 82, and 4 text figs.

Howard, L. O.—The Carpet Beetle, or "Buffalo Moth" (*Anthrenus scrophulariae*, L.). U.S. Dept. Agric., Bur. of Entom., Circ. No. 5, revised ed., 1908, pp. 1-4, 1 fig.

Lefroy, H. M.—The Red Cotton Bug (*Dysdercus cingulatus*, Fabr.). Mem. Dept. Agric. India, Entom. Ser., 1908, vol. ii, no. 3, pp. 47-58, plt. v.

Lefroy, H. M.—The Castor Semi-Looper (*Ophinsa melicerte*, Dr.). Ibid., no. 4, pp. 59-77, plts. v and vii, 3 text figs.

Lefroy, H. M.—The Tobacco Caterpillar (*Prodenia littoralis*). Ibid., no. 5, pp. 79-93, plt. viii, 1 text fig.

Lefroy, H. M.—Imported Insect Pests. Agric. Journ. India, 1908, vol. iii, pp. 237-244.

Lefroy, H. M.—Insect Pests of Mangel Wurzel. Agric. Journ. India, 1908, vol. iii, pp. 152-160.

Lefroy, H. M., and Ghosh, C. C.—The Mustard Sawfly (*Athalia proxima*, Klug.). Mem. Dept. Agric. India, Entom. Ser., 1908, vol. i, no. 6, pp. 357-370, plt. xx.

Lounsbury, C. P.—The Fusicladium Disease of the Pear and Apple. With notes on other Spot Diseases of these Fruits. Agric. Journ. C. of G. H., 1908, vol. xxxiii, pp. 16-32.

Lounsbury, C. P.—Woolly Aphis and Tobacco Extract. Agric. Journ. C. of G. H., vol. xxxiii, pp. 188-193, 1 fig.

Mackenzie, M., and Lefroy, H. M.—The Sugarcane Borers of Behar. Agric. Journ. India, 1908, vol. iii, pp. 104-124, plts. xx-xxii.

Mally, C. W.—Bee Pirates. Agric. Journ. C. of G. H., 1908, vol. xxxiii, pp. 206-213, 4 figs.

Marlatt, C. L.—The Woolly Aphis of the Apple. *Schizoneura lanigera*, Hausmann. U.S. Dept. Agric., Bur. of Entom., Circ. No. 20, rev. ed., 1908, pp 1-6, 2 figs.

Newell, W., and Barber, T. C.—Preliminary Report upon Experiments with Powdered Arsenate of Lead as a Boll Weevil Poison. State Crop Pest Comms. of Louisiana, No. 23, 1908, pp. 9-40, 3 figs.

Newell, W.—Destroying the Boll Weevils before they enter hibernation. State Crop Pest Comms. of Louisiana, Circ. No. 24, 1908, pp. 41-48.

Newell, W., and Treherne, R. C. A new predaceous enemy of the Cotton Boll Weevil. Ibid., pp. 244.

A Carabid known as *Evarthrus sodalis*, Lec.

Patel, C. U.—Katra (Hairy Caterpillars) in Gujarat. Agric. Journ. India, 1908, vol. iii, pp. 152-160.

Powell, H.—*Oryctes monoceros,* or large horned cocoanut beetle. Agric. Journ. Brit. E. Afr., 1908, vol. i, pp. 58, 59.

Sanderson, E. D.—Caterpillars injuring Apple foliage in late Summer. New Hampshire Agric. Exp. Stat., 1908, Bull. 139, pp. 207-228, 1-13.

Stockdale, F. A.—Root Disease of Sugar Cane. W.I. Bull., 1908, vol. ix, pp. 103-116.

This disease in the West Indies is chiefly caused by *Marasmius sacchari,* but it is thought that other fungi may be the cause of some of the damage noticed.

The symptoms, distribution, and spread of the disease are discussed together with remedial measures.

Stockdale, F. A.—Fungus Diseases of Cacao and Sanitation of Cacao Orchards. Ibid, pp. 166-189.

V.—Forestry.

VI.—Fisheries.

VII.—Medicine.

Girault, A. A.—The Indian Bedbug and the Kala Azar Disease. Science, 1907 (n.s.), vol. xxv, p. 1004.

Howard, L. O.—How Insects affect Health in Rural Districts. U.S. Dept. Agric., Farmers' Bull. No. 155, 1908, pp. 1-19, 16 figs.

Jackson, D. D.—Pollution of New York Harbor as a menace to health by the dissemination of Intestinal Diseases through the agency of the Common House Fly. Merchants' Assoc. New York, 1908, pp. 1-22, 7 plts.

A very valuable report showing a condition of sanitation and an apathy on the part of the Authorities that one would not have conceived possible in any civilized and educated community.

Manson, Patrick.—Recent Advances in Science and their Bearing on Medicine and Surgery. Lancet, 1908 (Oct. 3), pp. 991-997.

Navarre, P. J.—Les insectes inoculateurs de maladies infectieuses. Mém. Acad. Sci. Lyon, 1907 (3), T. 9, pp. 1-56, plts. i-v, 19 figs.

VIII.—Animal Diseases.

Anon.—East Coast Fever Legislation. Bill to Amend Previous Acts. Natal Agric. Journ., 1908, vol. xi, pp. 1020-1023.

Borrel, A.—Lympho-sarcome du chien. C. R. Acad. Sci. Paris, 1907, T. 144, pp. 344, 345.

Cameron, S. S.—Parasitic Skin Diseases. Journ. Dept. Agric. Victoria, 1908, vol. vi, pp. 444-448.

Donitz, W.—Die Texasfieberzecke *Boophilus annulatus*, und das Ixodinengenus *Margaropus*. Sitz.-Ber. Gesell. nat. Freunde Berlin, 1907, pp. 187-192.

Gates, B. N.—Bee Diseases in Massachusetts. U.S. Dept. Agric., Bur. of Entom., Bull. No. 75, Pt. III, 1908, pp. 1-32, plt. iv.

Saigol, R. O.—Experiments on "Rat Extermination." Indian Med. Gaz., 1908, pp. 254-256.

As a result of experiments made with various much advertised preparations the writer concludes: "Although hope had been extended from many quarters that rat extermination would be practicable by employing some micro-organism which would not only produce a disease in the animals directly experimented upon, but an infectious fatal disease among the rat population as a whole through these diseased rats being let loose, this has not been borne out by the experiments given above.

Supposing an organism is capable of producing an infectious, communicable disease among the rodents, it must do so through the infection being carried about in one or more of the following ways:—(1) by discharges; (2) by suctorial insects; and (3) by food (eating carcases).

That none of these means was potent enough in the case of any of the bacillary preparations experimented upon by me, is evident from the results. Further, no organism could be more virulent for rodents than the bacillus pestis, and yet rodents have not only not been decreased to any appreciable extent, but continue in such large numbers as to require special means to get rid of them.

The position therefore remains as it was before, and further experience will teach us what are the ways in which rats can be best got rid of, or whether measures ensuring the exclusion of free rats coming in contact with human beings would not be more beneficial as against rat extermination to which, practically, there seems no end."

Stiles, C. W., and Hassall, A.—Index Catalogue of Medical and Veterinary Zoology. U.S. Dept. Agric., Bur. An. Indus. Bull. No. 39, pts. 20 and 21, 1908, pp. 1493-1624.

Theiler, A.—Experiments with English and South African Redwater. Transv. Agric. Journ., 1908, vol. vi, pp. 534-543.

First Report of the Select Committee on East Coast Fever. Pp. xxxiv + 86 + v. Cape Town: 1908.

Stock-owners and veterinarians will welcome this First Report, for it places in their hands an authoritative statement on a disease which we are informed causes the loss of 95 per cent. of the cattle attacked.

The disease is spread by five species of ticks of the genus *Rhipicephalus*, and so far as is at present known this is the only means of communicating the disease from one animal to another.

The evidence of Messrs. P. J. du Toit, J. D. Borthwick, C. P. Lounsbury, C. E. Tod, and C. J. Levey is given, and contains much valuable information.

THE

JOURNAL OF ECONOMIC BIOLOGY.

PRIORITY AND PRACTICAL ENTOMOLOGY.

By

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In the Address of the President of the Entomological Society of London, at the Annual Meeting for 1907, the following sentence occurs: "For the last fifty years, names have been constantly changed, and there does not seem to be any immediate prospect of settlement." The paragraph in which this occurs (Proc. Ent. Soc., 1907, pt. v., p. cv.) deals with the question of priority in the names of insects. To a purist in nomenclature, who devotes time to finding the original descriptions of the oldest systematists' species, the correctness of the name to be applied to an insect is a matter of vital importance; this importance is purely academic and bears the same relation to practical entomology, that the variation in nomenclature of geologic strata does to the working prospector or mining surveyor.

There is a very large number of practical working entomologists who are engaged in dealing with insects as pests or as sources of benefit to mankind; these work over the whole globe, most in places far from the academic centres of the world. All correlation in work is based upon accurate diagnoses of insects, and it is all-important to them not only to correctly place and class their insects *on an uniform system applicable to all*, but to *use the same names throughout*, so that one working entomologist in Borneo say, reading the last bulletin on the "American Bollworm" from the United States, may know absolutely whether that insect is identical with any one of those he is familiar with, as it probably is.

I take this as a specific instance; we all knew the American bollworm as *Heliothis armigera*; there is a great literature on it, some extremely valuable. Quite lately, the British Museum issued part of a "Catalogue of Lepidoptera Phalaenae," a monumental work which deserves the gratitude of all entomologists. In this work, issued from

our National Museum, we find our old friend called *Chloridea armigera* in the text, but a few lines in the Appendix call it "*Chloridea obsoleta*." I would ask who is the better for this change; could not the author have stated that the specific name should, on strict priority, be *obsoleta;* could he not arbitrarily have used the generic name *Heliothis* to cover this group simply on the ground of its constant use during the last century, while stating that *Chloridea* was correct; it is no more an arbitrary thing to do than to state that he can identify this species with the species *obsoleta* of an older publication with which probably few systematists even will agree. Then think of the boundless confusion caused; we have all the old literature of economic importance under "*Heliothis armigera*"; we have now *Heliothis obsoleta*, *Heliothis armigera*, *Chloridea obsoleta*, *Chloridea armigera*. We are making nomenclature an end and not a means, and the level of the Science is sinking below that of stamp collecting. It may be said, why use the British Museum's Catalogue; to economic entomologists there is not time to go into these questions of priority except in so far as they affect literature; an authoritative catalogue, such as that of the British Museum should be, would naturally be the standard of an economic entomologist, who must work from the catalogues of systematists. If these catalogues are not authoritative, what is the use of them?

I have quoted at present one glaring instance. Their number is legion; in the Coccids, for instance, *Lecanium*, *Mytilaspis*, *Dactylopius*, *Coccus*, represented very clear groups recognisable at sight; but they have become *Coccus*, *Lepidosoaphes*, *Pseudococcus*, and *Dactylopius* respectively (to a large number, but not to all authors) on the ground solely of Mrs. Fernald's discoveries in priority; the poor student of *Coccidae* must learn these before he can benefit from both Nineteenth and Twentieth century authors, and in a recent Memoir of this Department, Mr. Green has to state that he maintains the old nomenclature and give the equivalents. This is a case as flagrant as any, since the *Coccidae* are notoriously important and since these generic names meant something definite to the student of economic entomology.

One may reasonably advance the view that the published work on the biology and economics of insects was just as important as the first or the second description, and the fact that a name has in economic literature represented a definite insect for half a century should out-weigh all considerations of academic priority. Yet it is perfectly clear that this view is not acted upon by even so practical a Department as that of the United States, which, in Bulletin 53, listing the economic-

ally important insects exhibited, have, in over thirty instances, to say "formerly known as ——— ———"; this is a catalogue designed for the public, not for the technical reader. If one wishes to identify *Heliothis armigera*, *i.e.*, to be able to apply to it a name by which it can be recognised by others in other countries, one does not delve in the old literature; one looks up whatever manual there is and uses that, with a reference, if necessary, to that manual as containing a description whereby the two workers may check their insects. But with the present arbitrary changes, due to priority, made on the authority of a single author, one must have the latest literature, one must give a list of synonyms, and in all our reference works (*e.g.*, Zoological Record) it will not be sufficient to refer to an insect by one name, but by several, as thus:—*Chloridea* (*Heliothis*) *obsoleta*, F. (*armigera*, F.). I would bring up also other notable instances; we all know the shorthorned grasshoppers and locusts as *Acridiidae*, the longhorned grasshoppers as *Locustidae*; it is unfortunate, perhaps, that the two were not originally transposed, but it emphasises very well to a class of students what nomenclature means when one explains why Locusts are not in the family *Locustidae*, and in this way the transposition of names is useful. But we are now told, by another British Museum Catalogue, that what we knew as *Acridiidae* are *Locustidae*, that the old *Locustidae* are *Phasgonuridae*, and that the *Gryllidae* are *Achetidae*, in spite of the fact that the notable Orthopterists, Brunner, Saussure, and Bolivar, found no occasion to change the old names. Suppose these to be adopted; the student has some text-books with one set, some with another, and has to learn the relative uses of them before he can get to his real work. If any branch of the science benefited, it would matter less, but none does.

I write as a "practical entomologist" (to quote Mr. C. O. Waterhouse) who has to deal with injurious insects, who directs men studying the live insect in the field and insectary, and who teaches students; it is a constant burden finding out the equivalents in different countries of the important insects, it has to be taught to students if they are to use literature at all, and it adds a needless complexity to a subject already sufficiently complex. Furthermore, as our insects are revised by authors at home we have to substitute new names, and these have to be circulated to all our scattered staff so that confusion may be avoided.

In this matter, teachers and practical entomologists alone are concerned; to the systematic entomologist, the mazes of synonymy and priority are (apparently) the breath of life, and the pastime might be a quite harmless one; if one systematist wants to abuse another in

the pages of an entomological journal, no one minds; it even adds an element of farce to an otherwise too sober publication when one Hemipterist has remarks on another. But to practical men who wish to check the growing spread of insects from country to country, who wish to co-operate to deal with big problems, who see in agricultural education the chief solution of these big problems, the question is one of vital importance.

The remedy for this state of things seems to me to lie in the formation either of an association of economic and teaching entomologists, or in the joint action of the various Associations and Societies to form an international committee. Such a committee could direct affairs by correspondence, the different associations doing the work for their own countries; thus for the British Empire, the Association of Economic Biologists and the Entomological Society of London combined could (1) obtain from every economic entomologist a list of the insects he regarded as having a sufficient importance in literature to be "Standardised"; (such a list is in existence in India for practical work, and I presume most entomologists in the Colonies have such working lists). (2) Work these lists into one (where necessary such lists could be easily correlated if specimens were sent, an easy matter if the species is economic and therefore not rare) and prepare a single list giving (*a*) proposed designation; (*b*) designation in use in economic literature; (*c*) designations in use in standard catalogues which contain good descriptions. (3) This list is then sent to the International Committee, who, by taking the advice of known experts in different groups, prepare one list, which is published for comment. (4) The comments are then scrutinised, and where a clear majority of say two-thirds are in favour of a name, it is adopted and used by all who subscribe to the aims of the committee. A reference then to the "International Catalogue" would enable systematists and others to refer to economic literature, and the single reference to the "International Catalogue" would enable every entomologist to know what he was dealing with.

I give below instances of the method of dealing with individual cases; I would point out that a vast majority of the destructive insects are those first found and described; it is just with these that "priority" makes such changes, and the nomenclature of not more than one insect in a hundred of our present recorded species would be touched by the committee at all. The realisation of this will perhaps tend to make the proposal look less revolutionary to pure systematists. I would include in the Committee's scope, the question of family names; practical working entomologists would adopt, not a standard classification, but a standard designation for well-marked families; thus *Bruchidae* are being called

Lariidae and *Mylabridae*, solely on grounds of priority; the Committee would, in my opinion, adopt *Bruchidae*.

It is obvious that to regulate such a matter as this must depend upon the mutual agreement of economic entomologists, which will be obtained only by a reasonable policy of compromise. One cannot lay down hard and fast rules; if a rule were made, for instance, that a name in use for the last half century should stand, the literature of 1855-1860 would be sought for to see if or if not the species described came within that limit, and we should have shifted the trouble from the time of Linnaeus to the decade of half a century ago. Mutual agreement would be the backbone of the system, or the chaos of the future arbitrary change or retention of nomenclature would be equalled only by the present chaos, and would duplicate it. There is no alternative that one can see except an arbitrary use of names according to one's own judgment. We have in India a well known pest *Hieroglyphus furcifer*, Serv. Mr. Kirby now finds this to be *H. banian*, Fabr., and he revives this name. Why should we adopt it? All our literature is under *furcifer*, and by retaining that name, no confusion is caused; but, the name may be adopted in Ceylon, Burmah, and other places; readers of our publications will be careful to point out the mistake, and to anyone not up in the question, there will appear to be two species.

Another instance has quite recently occurred; a moth was reared from stored potatoes grown in India in a locality to which seed potatoes had been imported from Italy. The suspicion arose that this was the notorious "Potato Moth" (*Lita solanella*). Mr. Meyrick was good enough to identify it as *Phthorimaea operculella*. What connection is there between these two? If one looks up the *systematic* literature one finds they are the same; but what practical working entomologist can afford to do this in every case and for every species? It involves a great deal of time, a constant purchase of otherwise useless literature, and is a great tax, wholly unprofitable. If I arbitrarily use *Lita solanella*, because my assistants and students can then look it up in agricultural literature, and everyone else uses *Phthorimaea operculella*, how are economic entomologists to know that India is a distributing centre for this pest in seed potatoes, and how are they to take precautions? I think all economic entomologists will agree that we are immensely adding to the difficulties of our work, if it is to be anything more than parochial, either by modifying our nomenclature in accordance with the priority discoveries of systematists or by arbitrarily using the nomenclature we think most suitable. It is impossible for an isolated worker in a far country to do more than offer suggestions; I feel assured it will be for the permanent ultimate good

of our science if we can overcome this growing monster, and I think the Association of Economic Biologists might fitly take up the subject.

It is perhaps premature to suggest that this might usefully be the first problem for the "International Institute of Agriculture" at Rome, as far as it covers insects important to agriculture, since presumably the listing of the pests of all countries will be one of their aims; but, with the support of economic entomologists of all countries, it should not be difficult to fix on an uniform system of family nomenclature and, for each well-defined pest, a fixed specific and generic name.

EXAMPLES.

(*a*) *Cimex* has been *Acanthia*; is now *Clinocoris* in America, *Klinophilos* in some literature. I would retain *Cimex*, these changes being purely due to priority. This is a splendid example: Bull. No. 47, cataloguing the Exhibit of United States Department of Entomology at Louisiana, dated 1904, gives "*Klinophilos lectularia*, Linn. (formerly *Acanthia* and *Cimex*)." Bulletin 53, dated a year later, listing the Exhibit at Portland, gives "*Clinocoris lectularia*, Linn. (formerly *Acanthia*, *Cimex*, and *Klinophilos*)." Here is a generic change in a popular exhibit and bulletin in one year.

(*b*) *Gelechia cerealella*, Ol., is now *Sitotroga;* this is due to revision of the unavoidably large genus *Gelechia*, and has the sanction of those who study *Microlepidoptera*, as being necessary. I would adopt the name as soon as the Association were satisfied that it was established in general use.

(*c*) *Pulex serraticeps*, Gerv., is now *Ctenocephalus canis*, Curt. If the genus *Pulex* must be split, owing to its including several genera, and if the name *Pulex* cannot be retained for all the "economic" ones (*i.e.*, species on which a literature exists), I would, after an interval, adopt the generic name; the specific change being simply a question of priority, would not be adopted.

(*d*) *Lecanium hemisphaericum* is now *Saissetia*, owing to division of the genus into several. In my opinion, the splitting of the genus is unnecessary, based on inadequate grounds, and I would vote for the retention of *Lecanium*; those to whom the sub-genera really conveyed anything useful could write *Lecanium* (*Saissetia*) *hemisphaericum*.

(*e*) Family Nomenclature.—A change in the designation of a family, on the grounds of a change in a generic name, should not be adopted; the actual names to be applied to Families to be settled and the equivalents listed; *e.g.*, the term *Trogositidae* should stand for the family containing the species known as *Trogosita mauretanica*, and any change would be rejected.

(*f*) *Leucania unipuncta*, Haw., designated, until recently, a pest practically world wide; Hampson, revising the genus, places it in *Cirphis;* the United States Department of Agriculture have adopted *Heliophila*. We have therefore the literature prior to 1900 say, under *Leucania*, the American literature now under *Heliophila*, and the literature of those who follow the British Museum Catalogue under *Cirphis*. This is to me a perfectly clear case where *Leucania* should have been retained for the part of the genus called *unipuncta*, regardless of priority, since it has been used for this important species for so long, and the economic literature under this designation vastly outweighs the importance of the systematic literature.

(*g*) *Psocus divinatorius*, Mull., was the original designation of the common household Psocid known the world over. The original genus was split, and the species passed as *Atropos divinatoria*. The American literature now designates it as *Troctes divinatoria*. In this case, I personally would vote for *Atropos*.

(*h*) *Protoparce convulvulli*, Linn., is the designation of the Eastern "Sweet Potato Hawk Moth," and is now regarded as the correct name for *P. singulata*, the Sweet Potato Hawk Moth of the Southern States and West Indies. Obviously both cannot stand; there is a literature under *cingulata;* there is none under *convulvuli*, and I would vote for the former. The genus has been revised by Hampson, who puts *convovuli* into *Herse*, by Rothschild and Jordan, who fix on "*Phlegethonthius*." If this species is the most important economic species, I would have retained *Protoparce*. If it is not, I would not have retained *Protoparce* for that part of the genus (now split up) which contained the most important species, *if the Committee were convinced the genus must be split at all.*

(*i*) The termite of India is written of as *Termes taprobanes*, Wlk., whilst it is *T. obesus*, Ramb. This is a case of mistaken identification, and the nomenclature must, of course, be corrected, since the two species are quite distinct.

(*j*) *Sylepta multilinealis*, Guen., was the designation of the very abundant Cotton Leaf Roller of India, Burmah, Straits, Ceylon, and Africa. Sir George Hampson, delving in old books, finds it agrees with *derogata*, Fabr. In a case of this kind, since the reference to Fabricius as distinct from Guenee is absolutely no value to anyone, and since the various entomologists of the large area the pest covers all know it as "*multilinealis*," I would unhesitatingly reject *derogata* as useless and frivolous.

(*k*) *Pyrilla lycoides*, Wlk. An amusing interchange of compliments has recently taken place over a species known in India as the

"Cane fly." It was erroneously identified as *Dictyophara pallida*, Don., and this designation adopted in "Indian Museum Notes," in "Indian Insect Pests," and in the "More Important Injurious Insects of India" (Mem. Agri. Dept. India, I., No. 2), in which I tried to fix our nomenclature for the time. In all these there was a clear mistake in identification, and the name was incorrectly applied. Mr. Distant then refers to it as *Zamila aberrans*, and we have now a choice of *Zamila* and *Pyrilla* as generic, and of *aberrans* and *lycoides* as specific names, according as we follow Mr. Distant or Mr. Kirkaldy. To discover all this, we have to refer to three places, "the Fauna of India," the "Entomologist," the "Annals of the Belgian Entomological Society," and there is still a choice of name.

SOME NEW AND UNDESCRIBED INSECT PESTS AFFECTING COCOA IN WEST AFRICA.

By

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With Plates VIII and IX.

Family **Capsidae**.

Gen. ? nov. **longicornis**, n. sp.

Pl. VIII, figs. 1 and 2.

Adult.—Head buff, mottled with brown. Ocelli two on papilla between antennae. Antennae a reddish brown, the clubs being dark brown. 1st segment short and broad, 2nd segment long and club-shaped, 3rd segment short and club-shaped, 4th segment pear-shaped and short. Beak dark brown, becoming darker towards the apex, four jointed. Thorax, dorsum of pro- and mesothorax, and scutellum of a buff ground colour, covered with dark brown pits and elevations, giving them a rasp-like surface. Wings—elytron, clavus buff, with dark markings and covered with black hairs. Corium buff, covered with black hairs. Cuneus buff, somewhat paler. Cell of membrane and membrane, buff mottled with dark and lighter slate coloured spots. Hindwing hyaline, with clear yellow veins. Legs reddish-brown with darker brown bars. Tarsus two-jointed, distal joint pale. Abdomen broad and flat, light brown, smooth. Length, 11 millim.

Hab.—Brafu, Yedra, S. Ashanti.

The female is armed with a long, curved ovipositor, carried in a groove on the venter.

The nymph has a very similar colouration, but the dorsum of the abdomen is of a reddish ground colour, with dark brown rectangular spots raised above the surface.

Very large numbers of these insects were found on the diseased trees and not on the healthy ones. They appear to damage the trees by perforating the bark and so producing "gumming."

Large numbers of nymphs in all stages were found, but no larvae or eggs.

Cryphalus horridus, n. sp.

Pl. VIII, fig. 3.

Head a dirty yellow. Beak not apparent, short. Eyes dark purple. Antennae capitate and geniculate, dirty yellow. Elytra and

dorsum of thorax a dirty olive green, covered with transparent stubby bristles arranged in longitudinal lines. Ventral surface a dirty yellow. Legs a pale yellow colour. Third joint of tarsi not lobed, fourth joint visible. The body is cylindrical and thick set. Length, 1 to 1.25 millim.

These minute beetles burrow between the bark and wood of the branches and twigs of the cocoa trees. They must be looked for carefully beneath the bark, as they are not to be found on the external surface of the branch. They make long cylindrical galleries, or burrows, in the deeper part of the bark, and so arrest the flow of the sap. Deep scarring is produced, the leaves turn yellow and fall, and the branches break off very readily at the points of the deepest scarring.

These beetles have caused a great amount of injury to cocoa this year in many plantations in S. Ashanti.

Cocoa is not indigenous to Ashanti, where its cultivation has been recently introduced. Having found that a minute weevil beetle was the cause of the damage to the crop, it became very important to discover the indigenous plant from which the weevils had transferred themselves to the Cocoa. After considerable search, I found similar weevils breeding in the tough outer portion of the Papaw fruit.

It apparently follows from this observation:—

i. That the planting of Cocoa in close proximity to Papaw is undesirable.

ii. That when a Cocoa plantation is once infected with these weevils, Papaws planted among the Cocoa trees might act as a trap for the beetles. This, however, requires experimental proof. I should like also to draw attention to the superficial resemblance between the fruit of the Cocoa and the fruit of the Papaw. Both are very similar in shape and colouration, and both grow from the main stem of the plant.

It would thus seem probable that these beetles are guided, in their choice of a plant, by sight rather than by smell or taste, and this observation may possibly afford some indication of the direction in which, in future, similar search is likely to prove successful.

Ceratitis anonae, n. sp.

Pl. IX, figs. 4-6.

The larvae are reared in the fruit of the Sour Sop (*Anona muricata*) and in that of the Guava (*Psidium cattleyanum*) in S. Ashanti.

Female.—Head, front broad, 1/3 width of head, lemon yellow with black orbital bristles. Cheeks fawn coloured. Eyes pale iridescent green, looking yellow, or brown, or blue, in parts, according to angle of

illumination. Ocelli on dark spot, with two ocellar bristles directed forward. Antennae yellow, a shade darker than the front. 1st segment short fringed with black hairs, 2nd segment short, studded with black hairs, 3rd segment three times length of 2nd segment. Arista pubescent, dark brown, long. Palps yellow, 2nd joint club-shaped and studded with black hairs. Proboscis a rusty-red, with fleshy labella bearing brown hairs. Thorax a greenish grey covered with pale yellow pubescence, with three dark brown longitudinal lines indistinct before, but broader and distinct behind the transverse suture, and ending slightly in front of scutellum in broad dark spots. Between these spots and scutellum is a narrow, shining glabrous band of cream or yellow. Pectus a dark brown. Pleurae lemon-yellow; rarely cream-coloured. Scutellum, the anterior third, is pale yellow or cream. The posterior two-thirds is shining black, divided into three parts by four golden narrow bands, which unite on the under side of the scutellum, four black scutellar bristles. Legs golden, middle tibiae with dark brown spurs. Abdomen broad, flat, of triangular shape, with well-marked flattened ovipositor. First segment pale buff or fawn, with a narrow dark brown basal band, covered with pale pubescence. Second segment with a dark brown apical band almost the entire width of the segment, covered with black pubescence. Third segment pale puff with pale pubescence. Fourth segment with a brown basal band. Ovipositor golden, first segment with brown apical band. Venter a pale brown. Wings broad and longer than body, transparent, with brown veins, and three transverse brown bands. A brown longitudinal between costa and third longitudinal vein, running from the anterior transverse vein to tip of wing. The middle transverse band has a golden spot, which lies in the first basal and in the discal cell. The longitudinal band has a golden central portion, and the brown edges are accentuated in four places as darker spots. There is in many specimens a faint, short brown band in the second posterior cell. In the basal part of wing, between the first and second transverse bands, there are eight brown dots, roughly arranged in two transverse lines. Halteres cream coloured, squama pale cream. Length, 6 millim.

Male.—Colouration similar to female. Front as broad as in the female. The antennae, thorax, pleurae, abdomen, and wings are very similar to those of the female. The legs differ: first pair, femora brown, tibia and tarsus golden; second pair, femora brown with long black hairs on under side, tibia brown with long black hairs on upper and lower edge, diminishing in length towards the tarsus, thus giving the appearance of a feather, tarsus golden; third pair, as in female. Length, 5.5 millim.

The fly is found walking lazily about on the leaves of various bushes, slightly vibrating its outstretched wings.

It is also found on palms where there are coccids.

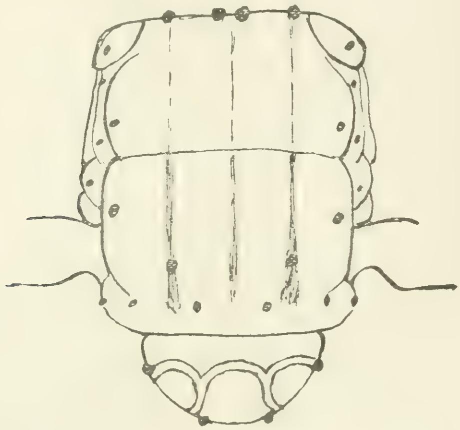


Fig. A.—Chaetotaxy of *Ceratitis anonae.*

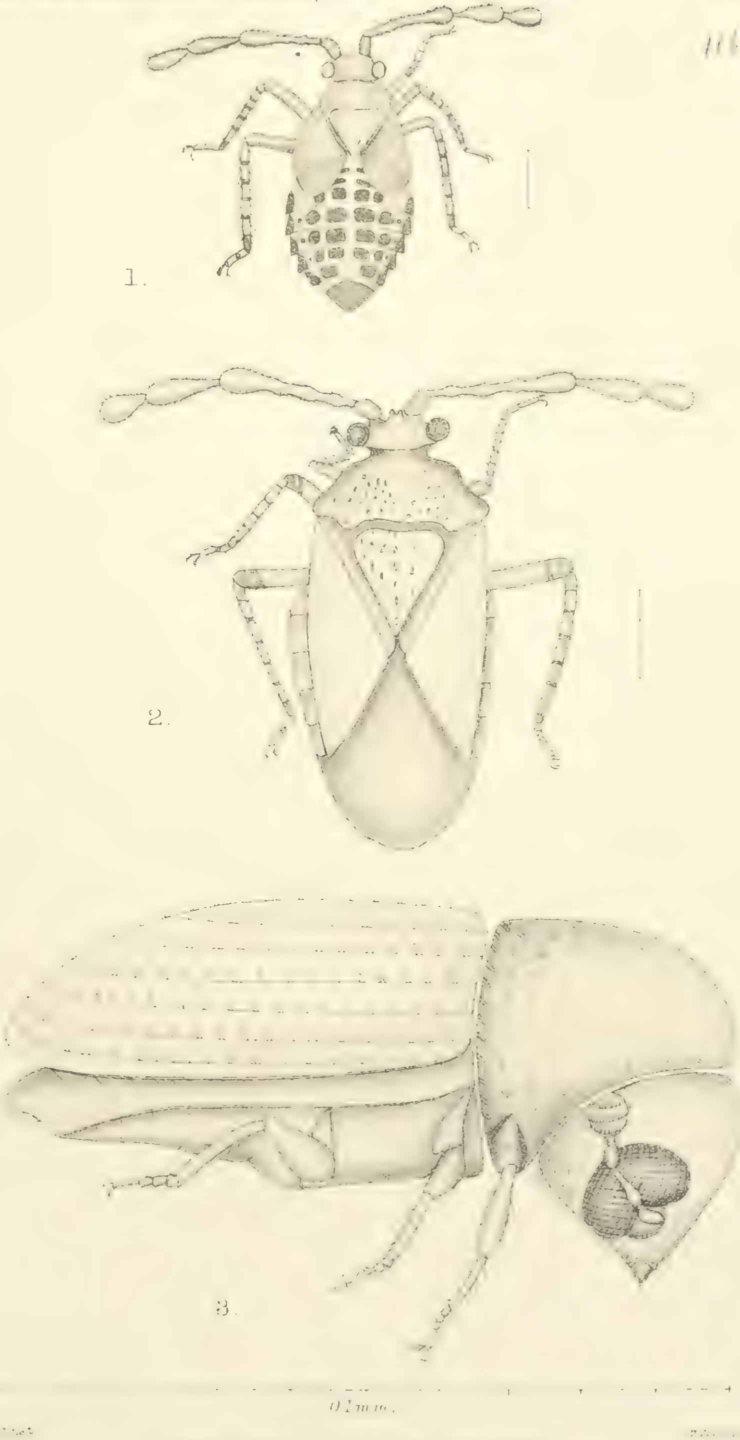
Chaetotaxy.—This is, of course, *Trypetid* in character, but I may point out that this peculiar arrangement of the four bristles on the anterior edge of the mesothorax is very easily recognised by unskilled persons, is characteristic, and renders *Trypetidae* readilv distinguishable from flies with pictured wings, such as *Ortalidae* and *Sciomyzidae*, to which some of the *Trypetidae* bear a superficial resemblance.

I have added a drawing showing the chaetotaxy.

The *larva* is a white maggot with a black spot and two dark hooks at the head end. It is capable of leaping. When placed on earth the larvae bury themselves and become pupa in two days. The pupal stage lasts thirteen days.

The *pupa* is of a golden brown colour.

The types of male and female are in the British Museum (Natural History).



NEW WEST AFRICAN INSECTS

CERATITIS ANONAE, *n.sp.*

EXPLANATION OF PLATES VIII AND IX,

Illustrating Dr. W. M. Graham's paper on "Some New and Undescribed Insect Pests affecting Cocoa in West Africa."

Plate VIII.

Fig. 1.—Nymph of ? *longicornis*, n. sp., found on diseased Cocoa plant at Brafu, Yedra, S. Ashanti.

Fig. 2.—Adult female.

Fig. 3.—*Cryphalus horridus*, n. sp. Adult female. × 97.

Plate IX.

Fig. 4.—*Ceratitis anonae*, n.sp. Male.

,, 5.— ,, ,, ,, Female.

,, 6.— ,, ,, ,,

a.—Larva.

b.—Pupa.

The small divisions of Scale represent millimetres.

THE FUTURE DEVELOPMENT OF TECHNICAL MYCOLOGY.[1]

By

EMIL WESTERGAARD, Ph.D.

ONE of the most striking examples of the recent rapid progress of pure and applied science is, without doubt, to be found in the rise of Technical Mycology. From being, for obvious reasons, non-existing prior to Pasteur, this branch of applied science, or rather the numerous branches which we now gather together under that common name, has since then developed into a position of one of the most fruitful and practically important subjects of the present time. The progress has indeed been so rapid, the amount of experimental work and the mass of literature so great, that it would seem not unprofitable to devote a few minutes to a consideration of the present position, and to try, if possible, to form an idea of the probable lines of further development in the immediate future. This would seem to be so much more useful as, owing to the reasons already mentioned, and also, and perhaps to an even larger extent, to the newness of the subject, the term "Technical Mycology" conveys, I am afraid, but a very vague meaning to most people who are not actually engaged in its pursuit.

Whilst the foundation-stone of this new science was laid by Pasteur through his demonstration of the importance of the presence and activity of distinct species and varieties of micro-organisms, it was reserved for Emil Chr. Hansen to show how our knowledge of microscopic plant life could be turned to practical use, and thereby to initiate the science of Technical Mycology as such. His idea, the systematic selection in each individual case of the most suitable type and the exclusion of all others, has, as you are undoubtedly aware, been adopted by the brewing industry throughout the world with the most conspicuous success. The same principle has since been applied to the distillery and yeast-making industry, chiefly by the Berlin school, and to wine-making by Muller-Thurgan and Wortmann, while in dairying the works of Duclaux and v. Freudenreich need only to be mentioned. While the importance of micro-organisms in the ripening of cheese is still a disputed question, their influence can scarcely be disregarded.

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[1] Read before the Association of Economic Biologists, Edinburgh Meeting, July 29th, 1908.

[JOURN. ECON. BIOL., 1908, vol. iii, No. 4.]

Even if it be admitted that the characteristic ripening of certain, or perhaps all kinds of cheese, is largely due to the activity of the natural enzymes of the milk, it is hardly possible not to ascribe to the bacteria at least some substantial part in the results. Even if bacterial influence should be shown to be of a negative nature only, we have still to reckon with the fact that the presence of lactic acid bacteria acts as a preventive against the development of the members of the putrefactive groups. The use of pure cultures in butter-making and recently in the manufacture of margarine, has given the most excellent practical results, of which the high reputation enjoyed by Danish butter affords a good example. This reputation very largely rests upon the uniformity of the quality, the natural result of the pure culture system.

Turning next to the greatest of all human industries—agriculture—we find that the questions which have so far chiefly engaged the attention of the technical mycologist are those connected with the bacteriology of the soil, and more especially the assimilation of free nitrogen, the nitrification and the denitrification. The first mentioned of these three questions is as yet very much in an experimental state, at least as far as practical results are concerned. The fixation of free nitrogen is of the highest importance in nature's economy, and the questions connected therewith are of such vital interest to the human race, that the discovery of the nodule bacteria of the *Leguminosae*, of the *Chlostridium pasteurianum* and the Azotobacter species, ranks among the most important scientific achievements of modern times. The apparent contradiction in the results of the practical experiments with pure cultures of nitrogen-fixing bacteria, finds its natural explanation in the pre-existence in the experimental fields of either sufficient nitrogenous food material for the plants or of an abundance of the necessary bacteria, or both. However, the question is only in its infancy, and presents a very promising field for further research, in the course of which it may possibly be found that the faculty of fixing free nitrogen is shared by numerous other organisms.

These few instances may suffice as examples of the direct utilisation of micro-organisms, or as it might be called the positive application of Technical Mycology. This science has, however, another side which may be called the negative one, consisting in the guarding against the inroads of micro-organisms which, by their development and activity, might exercise a more or less harmful influence upon the process of manufacture and the results of the industry. As examples may be mentioned sugar, starch, gelatine, and preserve works. Hereunder come the various processes of complete or partial sterilisation by heat, filtration, or chemical antiseptics, and, in a wider applica-

tion of the term, all the precautions against the spreading of infectious diseases of animals and plants. Pathological Mycology is, however, usually regarded as being outside the sphere of the Technical Mycologist, to which it can only be said to belong if fungi and bacteria are utilised directly to combat the disease-bringing organisms.

Of this we have a beautiful illustration in Metschnikoff's regulation of the bacterial flora of the alimentary canal by means of a systematic introduction of pure cultures of lactic acid bacteria.

This brings us on to the point on which I desire to say a few words, namely, the importance of the influence which micro-organisms exercise upon each other's development. The line which Technical Mycology has followed hitherto, and naturally must follow, has been the isolation of the most suitable species, variety, or type, for the particular industry in question, and an attempt to prevent complications by a rigorous exclusion of all others. The excellent results obtained in this manner have already been briefly alluded to and require no further comment, they speak for themselves. But it is nevertheless quite clear that if further substantial progress is to be made, not only in connection with the industries already within the domain of Technical Mycology, but if that science is to be extended to embrace other industries, the field of operations will require to be considerably widened. Just as we in the Algebra commence by considering the equations of the first degree, and gradually go on to the discussion of those of the second, third, and higher degrees, so we have in Technical Mycology commenced by mastering the problems of the first degree, those involving one species or variety of organism only, and are now face to face with the problems of the second and higher degrees, involving the simultaneous development of one or more either closely allied varieties or widely different species. These problems naturally fall into two classes. On the one hand we have such cases where any one species or variety does not carry out the entire amount of work required, and on the other hand we have such cases where the difficulties in sterilisation for one reason or another render the working of a pure culture, with the exclusion of admixtures, an impossibility. In addition may be mentioned those cases where the activity of micro-organisms is not in itself desired, but, as it cannot be avoided, an attempt is made to regulate it. As an example of the first class I should mention the brewing of British beers. Numerous, unfortunately unsuccessful, attempts have been made to carry through the fermentations of these by means of a single pure culture on the lines which have been such a great success in every other class of brewing. In a paper read before the Institute of Brewing, and afterwards in the Keith Lectures to the Royal Scottish Society of

Arts, I have expressed my views as to the lines on which this highly important and interesting question may be solved. These views are based upon numerous observations in practice as well as in the laboratory, indicating that when a mixture of micro-organisms is continually cultivated under the same set of conditions—food, temperature, time, etc., an equilibrium is soon established, after which the proportions in which the individual members are represented in the mixture are not changed to any appreciable extent. (It goes, of course, without saying, that this proportion may be, and in the majority of cases is, = 0; this is, the variety in question is eliminated). The exact scientific proof of the correctness of this statement is, unfortunately, still wanting, owing to the almost prohibitive difficulties in identifying such large numbers of cultures, so closely resembling each other, as would be necessary in this case. However, I have the best hope that I shall, before long, be able to complete this part of the work. As examples of the second class, we have distilling and yeast making and cheese making. It is well enough known how the temperature, and, in the case of distilling and yeast making, the reaction of the wash is regulated in order to control the development of micro-organisms. In this last-mentioned case we have in addition an example of the utilisation of bacteria, which are not in themselves desired, but are harmless, for the purpose of preventing the development of others. I allude to the addition of lactic acid bacteria to prevent Butyric fermentation. Of further examples of this class we have Metschnikoff's use of lactic acid bacteria, to which I have already referred. The question I propose to treat separately, and I shall, therefore, just now proceed to state the conclusions to which I have come.

"As it is only in exceptional cases that it is possible to work in practice with pure cultures absolutely free from the admixture of other organisms, and as it is necessary for the successful carrying on of several industries that more than one species or variety be employed, it is essential that the conditions affecting the relative development in mixtures of micro-organisms receive the most close attention of the Technical Mycologists."

This necessity opens up an almost unlimited field closely connected with biochemistry. The problems would seem to resolve themselves largely into a study of the enzymes and anti-enzymes, and the toxins and anti-toxins, the conditions regulating the production and activity of these, and the manner in which the development of the individual members present in mixtures are thereby affected.

In many cases the problem is probably simple enough, as for instance the suppression of *Saccharomyces apiculatus* in the wine

fermentation apparently by the large amount of alcohol produced by the wine yeast, or the prevention of putrefaction by the acid-forming species. But in numerous other cases the influences are undoubtedly of a far more subtle nature as, for instance, in the development of a British brewing yeast, or in the development of various bacteria in milk. It is true that if in this latter case the development of the lactic acid species is allowed to proceed sufficiently far to form an appreciable quantity of free acid, the retarding effect of this upon the development of a great many other organisms will be so strong that it will overshadow most other factors. I am, however, convinced from what I have seen during my work with bacteria in milk that there are other factors at work, and I propose to lay before you the results of my experiments so far as they go and incomplete as they are.

It is now a couple of years since Dr. A. P. Laurie called my attention to Metschnikoff's ideas, and suggested that I might be able to do something to have these introduced into this country. After having made myself acquainted with the literature on the subject, I proceeded to isolate a number of lactic acid bacteria from various sources. In estimating the relative value of these I used their power of retarding the development of a culture of *Bacillus coli communis*. I chose this method partly because it appeared to me that members of this group were the principal mischief makers in the alimentary canal, partly because it seemed evident that the suppression of members of the putrefaction groups would present no difficulties, and partly because the *Bacillus coli* varieties being themselves lactic ferments, would probably be in a position to offer more resistance towards the lactic acid bacteria than most others, so that a type of the latter which was able to combat successfully *Bacillus coli* might be confidently expected to come out victorious from the competition with most other species.

The culture which I finally adopted was a *Streptococcus* form obtained from a sample of butter from Normandy, and of this I supplied during nearly a year a large number of samples daily to several of my friends in the medical world. I do not propose to say anything about the medical aspect of the question, on which I am, of course, totally incompetent to speak, but I shall only refer to a publication by Dr. A. Veitch in the "British Medical Journal" (10th August, 1907), and I hope that others will soon be in a position to publish their results, which, I understand, are in many cases of a highly satisfactory nature.

In the following experiments the culture of *Streptococcus acidi lactici* already referred to was used. The culture of *Bacillus coli communis* was obtained by isolation from human faeces and developed in Glucose-Peptone Solution ($\frac{1}{2}$% Peptom Witte and 2% Glucose).

EXPERIMENT (A).

Both cultures were developed for 24 hours at $37\frac{1}{2}^{\circ}$ C. in Glucose-Peptone. One drop of each of these cultures was added to a Freudenreich flask containing about 7 cc. Glucose-Peptone Solution, which was then placed in the incubator at $37\frac{1}{2}^{\circ}$ C. From this neutral Glucose-Peptone-Gelatine, plates were made after 24 hours and 48 hours incubation. One drop of the culture was diluted with 10 cc. sterile water. Of this dilution one drop was again transferred to 10 cc. sterile water, and from this one drop transferred to the Gelatine. After development the number of colonies of each type was counted, the difference in their appearance being of course sufficiently great to make this a comparatively easy, although rather tedious, piece of work. For further confirmation twelve colonies of each description were taken out of each plate in this and also in the following experiments, developed in Glucose-Peptone Solution and examined under the microscope.

Results of Counting.

Plate made after 24 hours. Total number of colonies = 75.

B.C.C.	6.6%
S.A.L.	93.4%

Plate made after 48 hours. Total number of colonies = 631.

B.C.C.	12.8%
S.A.L.	87.2%

EXPERIMENT (B).

Same as (A) with the exception that a large excess of calcium carbonate powder was here added to the Glucose-Peptone Solutions.

Results of Counting.

Plate made after 24 hours. Total number of colonies = 2,800. (Only one-fourth of the plate counted).

B.C.C.	8.8%
S.A.L.	91.2%

Plate made after 48 hours. Total number of colonies = 317.

B.C.C.	11.3%
S.A.L.	88.7%

These results would seem to show:—

(1). That the S.A.L. possesses in a very high degree the power of checking the development of B.C.C.

(2). That during the initial, and probably decisive, stages in the competition, this power does not depend upon the formation of lactic acid, as in both experiments a slight increase in the percentage of B.C.C. colonies is observed in the 48 hours plates as compared with those made after 24 hours, and, further, the results are practically identical in both experiments, the presence of calcium carbonate having apparently no effect.

EXPERIMENT (C).

The object of this experiment was to show to what extent the presence of B.C.C. in overwhelming numbers from the beginning of the experiment would affect the results. The Glucose-Peptone Solution was therefore infected with a drop of the B.C.C. culture alone, incubated for 24 hours at $37\frac{1}{2}^\circ$ C., and then a drop of the S.A.L. added. The culture was then again placed at $37\frac{1}{2}^\circ$ C., and plates made after 24 and 48 hours as before.

Results of Counting.

Plate made after 24 hours. Total number of colonies = 473.

B.C.C.	11.8%
S.A.L.	88.2%

Plate made after 48 hours. Total number of colonies = 1,374.

B.C.C.	8.1%
S.A.L.	91.9%

From these results it will be seen that the large number of B.C.C. has not seriously affected the development of S.A.L., and it would seem justified to expect that if the conditions were reversed, if the B.C.C. had to compete against a very large majority of S.A.L., it would scarcely develop at all.

The results of experiments (A) and (B), however, seemed to indicate that the position might possibly be a more complicated one, and in order to try this the following experiment was carried out, in which the only difference from (C) was that in this case S.A.L. had the 24 start.

Results of Counting.

Plate made after 24 hours. Total number of colonies = 90.

B.C.C.	5.5%
S.A.L.	94.5%

Plate made after 48 hours was lost by accident.

Taking the results of all four experiments together, the evidence seems to be in favour of the opinion that the retarding effect upon the

development of B.C.C. exercised by S.A.L. is not merely due to the formation of lactic acid, and would further seem to indicate that if mixtures of the two bacteria here mentioned are cultivated under conditions which preclude the formation of large quantities of free lactic acid, an equilibrium between the two species, approximately in the proportion of 1 to 9, would be established.

It seems quite possible that the power possessed by the lactic acid bacteria of retarding the development of other bacteria, or at least most of the bacteria in milk, could be utilised for the purpose of increasing the purity of our milk supply. The bacterial contents of milk, as it is now retailed, more especially in large cities, are such that improvements are very urgently needed, as is amply proved by practically every report from Medical Officers of Health. Excellent information on this subject is also contained in the report just issued by the Committee appointed by the East and West Ridings of Yorkshire and adjoining counties, in which it is clearly shown how much can be done by observing the most scrupulous cleanliness in the dairy farms as well as in the retailers' and consumers' places; but the question still remains whether a milk supply obtained under the most ideal conditions that would be practicable, could be safely regarded to be without risk of causing or spreading disease. The remedy which has so often been advocated and tried—but so far with very little success—is that of sterilising, or partly sterilising the milk. The great objection to this process is that milk so treated will still contain a fairly large number, especially of spore-forming bacteria, which, when the milk is kept, will develop side by side with those bacteria which reach the milk after the sterilisation process. As the lactic acid bacteria have all been killed, such milk will not become sour and thereby indicate that it has been kept too long, in fact a sample of so-called sterilised milk may perfectly well be swarming with bacteria without exhibiting any sign of their presence, at least not to the eye of the ordinary consumer, who has been accustomed to look upon any sample of milk that is not sour as being good. What calamities can be, and undoubtedly are being caused by the use of such milk which is actually in a state of decomposition, can better be imagined than described. If the milk, however, had received immediately after the sterilisation process just a trace of a pure culture of lactic acid bacteria specially selected for the purpose, this great objection and danger would have been entirely done away with. The presence of these bacteria would not only retard the development of others, but would ultimately, by their own development, indicate when the milk had been kept too long; and quite apart from the question of sterilising the milk, it would seem quite possible to

improve the purity of the natural milk by the addition of such cultures immediately after the milking process. The cost of this, if it were carried out regularly, would be quite insignificant, and the presence of the lactic acid bacteria in the milk from the very outset would probably afford the best safeguard against the development of the various more or less undesirable species.

Before concluding, I think I should mention that the experiments which I have described were not carried out with a view to publication, at least not in their present form, but when I was requested a few weeks ago to make some remarks at this meeting, it occurred to me that the results, and the ideas which they seem to suggest, might be of interest to some of those present.

NOTES.

Preliminary Note on the Action of Yohimbine on the Generative System.

BY

W. CRAMER, Ph.D., D.Sc., and F. H. A. MARSHALL, M.A., D.Sc.

(*From the Physiology Department, University of Edinburgh.*)

Seeing that the drug Yohimbine is commonly stated by veterinarians to act as an aphrodisiac, and that it has been claimed by some to be capable of inducing a condition of " heat " in animals and to be an effective remedy for certain kinds of sterility, it seemed desirable to undertake a systematic investigation upon the precise nature of the action of this drug on the female generative organs. We first administered it to two small anoestrous bitches, the date of the preceding " heat " period having been noted for one of them, but not for the other. Each animal received about .005 grams of Yohimbine twice daily, for nearly a fortnight, the drug being administered in the form of tablets, which were eaten. A marked congestion of the vulva resulted, especially in the case of the dog whose previous " heat " period had been noted to occur a few weeks previously.

After ceasing to administer the drug the effects passed off, and the vulva once more became pale. This result agrees with that obtained by Daels (" Surgery, Gynaecology and Obstetrics," February, 1908).

We then proceeded to investigate the effects of Yohimbine on the generative organs of rabbits. These animals received twice daily doses of .005 grams by the mouth in the form of tablets. The external generative organs became very deeply congested after a few days. Moreover, it was found on killing the rabbits that the uterus and entire generative tract were also congested, sections showing that the vessels were much engorged with blood. It also appeared that the uterine mucosa had undergone growth in consequence of the treatment, but whether these changes are to be regarded as truly prooestrous must still remain an open question. The ovaries were much overgrown by luteal tissue, and degenerate follicles, which are generally so common in rabbits' ovaries, were relatively scarce. It seems extremely probable, therefore, that Yohimbine, by preserving a constant and rich supply of blood, and consequently of nutriment, to the ovaries, may arrest the normal process of follicular degeneration, and so be the means of bringing a larger number of follicles to maturity than would otherwise be the case, thereby tending to increase the fertility. There was no evidence, however, that Yohimbine by itself is capable of

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inducing ovulation in the rabbit, this animal differing from most in its failure to ovulate, except as a result of a nervous reflex set up by sexual intercourse.

Lastly, evidence was adduced that Yohimbine may promote mammary development and the secretion of milk, since in five rabbits to which the drug was administered milk was found in considerable abundance in the glandular tissue, in spite of the fact that the animals had not recently been suckling; while in another virgin rabbit there was distinct evidence that Yohimbine had promoted a hypertrophy of mammary tissue to an extent at least as great as that observed by Miss Lane-Claypon and Starling after the injection of foetal extract. It will, however, be necessary to confirm this observation before we can speak more definitely in regard to the action of Yohimbine on the mammary glands.

A Note on Abortion as a Result of a Diet rich in Carbohydrates.

BY

W. CRAMER, Ph.D., D.Sc., and F. H. A. MARSHALL, M.A., D.Sc.

(From the Physiology Department, University of Edinburgh.)

In a recent paper (Proc. Roy. Soc., B. 1908), Lochhead and Cramer showed that in the pregnant rabbit there is a distinct relation between the amount of glycogen in the placenta and the growth of the foetus. A diminution in the glycogen of the placenta, whether occurring spontaneously or produced experimentally, was accompanied by a diminution in the weight of the foetus. The amount of glycogen present at any one day of pregnancy was found to be remarkably constant, and could not be increased by feeding the pregnant animals on a diet rich in carbohydrates (carrots). It was noted, however, that out of six pregnant animals which were kept on such a diet, three aborted.

In the present investigation the effect of such a diet was tested again on twelve female rabbits, which were kept intermittently with the same buck. Six of them were then fed on cabbage and carrots, while six others were fed on cabbage and oats, the latter serving as controls. Of the six control animals all had normally developed young ones. Of the six rabbits fed on carrots, three aborted at different stages of pregnancy.

This result agrees with the experience of many stock owners, that cows fed on molasses prove to be uncertain breeders (See Wallace: "Farm Live Stock," 1907), and that Lincoln sheep fed solely on turnips are especially liable to abortion (Heape, Journ. Roy. Agricultural Soc., 1899), but the last-mentioned fact has been ascribed by Heape to the fouling of the roots by mud and excrement, a condition of things which results from overcrowding.

REVIEWS.

Bailey, L. H.—The Horticulturists Rule Book. Pp. ix + 312. Toronto: The Macmillan Company of Canada, Ltd., 1908.

This is a special edition of Professor Bailey's well-known handbook printed for the Government of British Columbia, for distribution amongst members of the Farmers' Institute.

It is cram full of valuable and useful information bearing upon insecticides, injurious insects, plant diseases, injuries from mice, rabbits, birds, etc., weeds and moss, seed-tables, planting-tables, and information upon the methods of keeping and storing fruits and vegetables, in addition to a large series of tables, elements, symbols, analyses, etc., etc.

We commend this handy reference book to all horticulturists and gardeners.

W. E. C.

Henslow, G.—The Heredity of Acquired Characters in Plants. Pp. xii + 107. London: John Murray, 1908. Price 6s. net.

The Rev. George Henslow, in this volume, maintains the thesis that evolution in plants depends on the inheritance of characters which have their origin in direct adaptation of the organisms to new environments; adaptations which become fixed or hereditary if the plants live long enough, generation after generation, in their new surroundings. Opposed to this is the view that variations are congenital, appearing in the seedlings, the unfit being eliminated, whilst the fittest survive, a view in harmony with Weismann's theory of the germ plasm.

Numerous examples in support of the author's view are marshalled from such groups of plants as the xerophytes (drought-loving plants), climbers, aquatics, etc. It is argued that in the xerophytes the succulent habit is a direct adaptive response on the part of the plant to the new environment, and that through successive generations this succulency becomes hereditary. In this, as in his earlier book, "The Origin of Plant Structures by Self-Adaptation to the Environment," the author appears to consider one factor to the exclusion of others. The environment cannot alone be the direct cause of the succulent habit, because examination of various plants, growing under the same conditions, shows that whilst some plants are succulent, others have underground bulbs and rhizomes, hairy leaves, a spinous habit, an extraordinary development of the root system, and so on. In other words, the same environment produces very dissimilar results, according to the personal equation of the plant and its response to tendencies already hereditary and not directly induced *de novo* by the action of the environment alone.

It is impossible, in a brief notice such as this, to do full justice to a book which, with the author's previous works, will be appreciated by botanists for the wealth of interesting examples cited, even although in all cases we find ourselves scarcely able to accept fully his conclusions.

The book is well produced and illustrated.

W. F. G.

Hunting, William.—Glanders, A Clinical Treatise. Pp. 105, with 17 plts. London: H. and W. Brown, 1908. Price 10s. 6d. net.

Veterinary science, and pathologists in particular, are much indebted to the author for this beautifully illustrated treatise. No one in this country is more capable or better qualified than Mr. Hunting to write on the subject of glanders, for he has taken a keen interest in, and has been practically associated with, the disease for now nearly a quarter of a century.

Modestly, but with a dogged pertinacity, he has spared no effort to keep the importance of the subject before succeeding Governments, and to impress upon them the seriousness of the disease to the health and wealth of the nation.

The disease is lucidly described, its history, etiology, symptoms, post-mortem appearances, diagnosis, the mallein test, cure and recovery, prevention and legislation, with an important appendix on glanders in man.

The work cannot fail to help those whose experience is small, in providing them with the fullest information, and will assist them to detect and suppress the disease should they meet with it.

There is little doubt but that so valuable a contribution to the literature of veterinary pathology will find a place in the library of everyone who has to deal with diseases of the horse. It is ably written, and leaves nothing to be desired in the manner in which it has been presented to the public.

W. E. C.

Neumann, L. G.—Parasites et Maladies Parasitaires des Oiseaux Domestiques. Pp. viii + 230, 89 text figs. Paris: Asselin et Houzeau, 1909.

In a remarkably small compass Professor Neumann has given an admirable description of the parasitic diseases of fowls and other domestic birds.

The descriptions of the various parasites are concise, lucid and well-illustrated throughout, whilst the inclusion of the common and scientific names and authorities make this a most useful handbook.

No pains seem to have been spared to make it as thorough and complete as possible.

W. E. C.

Pickering, S. U., and Theobald, F. V.—Fruit Trees and their Enemies, with a Spraying Calendar. Pp. i + 113. London: Simpkin, Marshall, Kent and Co., Ltd., 1908. Price 1s. 6d. net.

It is difficult to imagine what induced the authors to compile the little work before us. All that it contains has been said before and said much better, whilst its brevity, in many cases, detracts from its value.

The much debated "Woburn Washes" are strongly recommended, but up-to-date fruit growers will, we feel sure, hesitate before they treat their trees with caustic soda emulsions and paraffin mixtures. As is now well-known both caustic soda and paraffin do considerable harm to plant life, and are only partially successful in the destruction of insect pests; apart from this fact, their price is beyond the reach of the man who grows for profit.

The injunction to collect and burn all fallen leaves, as they may be infested with eggs, etc., of injurious insects, fungus spores, etc., if carried out, would mean two to three months' hard work for a small army of men, which practical fruit-growers will smile at. Such an injunction as this is most unfortunate, coming as it does from the advisers of the Duke of Bedford's Experimental Fruit Farm and the Wye Agricultural College.

W. E. C.

Fuhrmann, O.—Die Cestoden der Vögel. Zool. Jahrb. Suppl. 10, plt. i, Pp. 232. Jena: Gustav Fischer, 1908.

Dr. Fuhrmann has written a most interesting work, both from the standpoint of the parasitologist as well as ornithologist. The fact that the different parasites bear a distinct relationship to the different groups of birds is one worthy of further study.

It is, however, as a treatise on parasitology that it commends itself to our notice. As is fairly well-known the Cestodes are especially numerous amongst birds, and present many widely differing types. No less than sixty-four generic types are here treated of, together with the particular group of birds in which they are found. In many cases these generic types include a large number of species, all of which are set forth with full details.

The work is of considerable value to the parasitologist, and cannot fail to interest economic biologists generally.

W. E. C.

CURRENT LITERATURE.

I.—General Subject.

II.—Anatomy, Physiology, and Development.

Bordas, L.—Recherches sur les glandes défensive ou glandes odorantes des Blattes. Ann. d. Sci. Nat. (Zool.), 1908, pp. 1-25, pl. i.

Bruntz, L.—Les reins labiaux et les glandes cephaliques des Thysanoures. Arch. Zool. exp. et gen., 1908, pp. 195-238, pls. ii, iii.

Carter, R. M.—A Preliminary Note on Spirochaetosis in Southern Arabia and the Morphology of the Parasite. Indian Med. Gaz., 1908, pp. 370-374, plts. i-v.

Felt, E. P.—Circumfili of the *Cecidomyiidae*. New York State Mus., Bull. 124, 1908, pp. 305-307.

The peculiar antennal structures first discovered by Targioni-Tozetti in 1888, are most highly developed in the male Diplosids, where they consist of nearly homogenous whorls of long, looped filaments extending around the enlargements of the segments. These structures occur practically in all the *Cecidomyiinae*, but are not present in the *Lestreminae*. In the genus *Lasioptera* they are extremely simple in form, and in *Cincticornia* they present somewhat remarkable modifications, whilst the most unique type is found in the genus *Winnertzia*.

The author puts forward the view "that these organs may be hypodermal structures, which, through a process of development, have migrated from the interior of the antennal segment, becoming external, and thus greatly increased their value as auditory organs." An alternative explanation is that they are simply specially modified setae, and this is the view we prefer to take until further evidence is forthcoming.

Hewitt, C. Gordon.—The Structure, Development and Bionomics of the House-fly, *Musca domestica,* Linn. Pt. II. The Breeding Habits, Development and Anatomy of the Larva. Quart. Journ. Micro. Sci., 1908, pp. 495-545, plts. 30-33.

Minchin, E. A.—Investigations on the Development of Trypanosomes in Tsetse-Flies and other Diptera. Quart. Journ. Micro. Sci., 1908, pp. 159-260, plts. 8-13, and 2 text figs.

Nuttall, G. H. F., Cooper, W. F., and Robinson, L. E.—On the Structure of "Haller's Organ" in the *Ixodoidea*. Parasitology, 1908, vol. i, pp. 238-242, plt. xviiii, 1 text fig.

From an examination of the structure of this organ, which is borne on the dorsal surface of the tarsus of the first pair of legs, the authors come to the conclusion that it is not auditory in function, but, as advanced by Lahille in 1905 from experiments, olfactory.

The minute structure is now described for the first time, and this and Lahille's experiments are all strongly in favour of the assumption that the organ is olfactory in function.

Patton, W. S.—Preliminary Report on the Development of the Leishman-Donovan Body in the Bed Bug. Sci. Mem. Off. Med. San. Dept. Govern. India, 1907 (n.s.), No. 27, pp. 1-19, 1 plt.

Thompson, O. S.—Appendages of the Second Abdominal Segment of Male Dragon Flies (Order Odonata). New York State Mus., Bull. 124, 1908, pp. 249-263, figs. 17-28.

III.—General and Systematic Biology, and Geographical Distribution.

Chadwick, G. H.—A Catalogue of the "Phytoptid" Galls of North America. New York State Mus., Bull. 124, 1908, pp. 118-155, plt. 3.

The author gives a list of host plants on which leaf-galls occur. We fail to see the value of such. A list of the *Eriophyidae* of North America would have been extremely useful.

Cockerell, T. D. A.—A Remarkable Cecidomyiid Fly. Canad. Entom., 1908, pp. 421, 422.

Under the name of *Hormomyia coloradensis*, n.sp., the author describes a somewhat peculiar Cecidomyiid, in which the third vein of the wing is continued straight to the base of the fifth, and a little cross-vein to the first, which is supposed to be the real beginning of the third, is totally absent.

Felt, E. P.—New Species of *Cecidomyiidae. II.* New York State Mus., Bull. 124, 1908, pp. 286-304.

Fifty-one new species are described.

Felt, E. P.—Studies in Cecidomyiidae. II. New York State Mus., Bull. 124, 1908, pp. 307-422, plts. 33-44, figs. 29-49.

A valuable paper containing much new information respecting the American *Cecidomyiidae* and the Family as a whole.

The following genera are described as new:—*Microcerata, Neolasioptera, Camptoneuromyia, Diarthronomyia, Walshomyia, Sackenomyia, Cincticornia, Dentifibula, Lobodiplosis, Karshomyia, Youngomyia, Pro-*

diplosis, Odontodiplosis, Adiplosis, Hyperdiplosis, Giardomyia, Metadiplosis, Epidiplosis, Paradiplosis, Obolodiplosis, and *Johnsonomyia*. Many of these are founded upon little more than specific characters, and we regret that the author has not, at all events for the present, included them in existing genera.

Girault, A. A.—The Oviposition of *Chilocorus bivulnerus,* Mulsant. Journ. Econ. Entom., 1908, vol. i, pp. 300-302.

Houghton, C. O.—Notes on the Lesser Clover-leaf beetle (*Phytonomous nigrirostris,* Fab.). Journ. Econ. Entom., 1908, vol. i, pp. 297-300.

Howard, C. W.—A List of the Ticks of South Africa, with Descriptions and Keys to all the forms known. Ann. Transv. Mus., 1908, vol. i, pp. 73-169, plts. i-xvi.

Although describing no new species, this is a most useful and valuable paper. In addition to giving full diagnostic characters, and numerous figures, the author includes a bibliography of South African ticks and a list of the animals which act as hosts for the same.

Johannsen, O. A.—New North American *Chironomidae.* New York State Mus., Bull. 124, 1908, pp. 264-285.

Kirby, W. F.—A Gall-producing Dragon-Fly. Nature, 1908, p. 68.

Mercier, L.—Recherches sur les bactéroides des Blattides. Arch. Protistenkunde, 1907, Bd. ix, pp. 346-358, 2 Tafn.

Meunier, F.—Monographie des *Empidae* de l'ambre de la Baltique. Ann. d. Sci. Nat. (Zool.), pp. 81-135, plts. iii-xii.

Needham, J. G.—New Data concerning May Flies and Dragon Flies of New York. New York State Mus., Bull. 124, 1908, pp. 188-248, plts. 10-32, and figs. 5-16.

Neumann, L. G.—A new species of Tick from the Transvaal. Ann. Transv. Mus., 1908, vol. i, pp. 170-172.

The new species is named *Rhipicentor vicinus.*

Pease, S. A.—Parasites and the State Insectary. Rpt. 34th Fruit Growers' Convention Calif., 1908, pp. 39-49.

Pierce, W. D.—Factors controlling Parasitism with special reference to the Cotton Boll Weevil. Journ. Econ. Entom., 1908, vol. i, pp. 315-323.

Scott, Hugh.—On certain *Nycteribiidae,* with descriptions of two new species from Formosa. Trans. Entom. Soc. Lond., 1908, pp. 359-370, plt. xviii.

Silvestri, F.—Liste des *Japygidae.* Ann. d. Sci. Nat. (Zool.), 1908, pp. 151-157, 17 figs.

Smith, J. B.—Notes on some *Cecropia* cocoons and parasites. Journ. Econ. Entom., 1908, vol. i, pp. 293-297.

Townsend, C. H. T.—A Record of Results from rearings and dissections of *Tachinidae*. U.S. Dept. Agric., Bur. of Entom., Tech. Ser., No. 12, pt. vi, 1908, pp. 95-118, figs. 25-30.

Webster, R. L.—The Eggs of *Empoasca mali*, Leb. Journ. Econ. Entom., 1908, vol. i, pp. 326, 327.

Wesché, W.—The systematic affinities of the *Phoridae* and of several Brachycerous families in Diptera. Trans. Entom. Soc. Lond., 1908, pp. 283-296, plt. vii.

IV.—Agriculture and Horticulture.

Berger, E. W.—The Citrus Whitefly of Florida consists of two species. Journ. Econ. Entom., 1908, vol. i, pp. 324, 325.

Chittenden, F. H.—The Strawberry Weevil (*Anthonomus signatus*, Say.). U.S. Dept. Agric., Bur. of Entom., Circ. No. 21, rev. ed., 1908, pp 1-10, 5 figs.

Chittenden, F. H.—The Squash-Vine Borer (*Melittia satyriniformis*, Hbn.). U.S. Dept. Agric., Bur. of Entom., Circ. No. 38, rev. ed., 1908, pp 1-6, 2 figs.

Chittenden, F. H.—The Rose Slugs. U.S. Dept. Agric., Bur. of Entom., Circ. No. 105, 1908, pp. 1-12, 4 figs.

The term slugs is used here with about the same exactitude as the American entomologist uses the term "worm." The circular treats of three species of sawflies.

Cook, A. J.—Parasitic Control of Injurious Insects. Rpt. 34th Fruit Growers' Convention Calif., 1908, pp. 49-55.

Evans, I. B. P.—The Citrus Fruit-Rot caused by the Blue-Mould, *Penicillium digitatum* (Fr.), Sacc. Transv. Agric. Journ., 1908, vol. vii, pp. 60, 62, 2 plts.

Evans, I. B. P.—The New York Apple Tree Canker or Black Rot Fungus in South Africa. Transv. Agric. Journ., 1908, vol. vii, pp. 62-64, plt. 7.

Evans, I. B. P.—Potato Rot (*Nectria solani*, Pers.). Transv. Agric. Journ., 1908, vol. vii, pp. 64, 65, plt. 8.

Felt, E. P.—23rd Report of the State Entomologist, 1907. New York State Mus., Bull. 124, 1908, pp. 5-60, plts. 1, 2, and 1 fig.

Forbes, S. A.—Twenty-fourth Report of the State Entomologist on the Noxious and Beneficial Insects of the State of Illinois. Pp. xvi + 168, 11 plts. Bloomington, 1908.

A report full of valuable information. Apart from the account of the excellent experimental work, there are numerous life-histories detailed and beautifully illustrated.

Foster, E.—The Introduction of *Iridomyrmex humilis* (Mayr) into New Orleans. Journ. Econ. Entom., 1908, vol. i, pp. 289-293.

Gillette, C. P.—Notes and Descriptions of some Orchard Plant Lice of the Family *Aphididae*. Journ. Econ. Entom., 1908, vol. i, pp. 302-310, plts. 5, 6.

Gunn, D.—Locust Destruction Work in the Transvaal. Transv. Agric. Journ., 1908, vol. vii, pp. 75-80, 2 maps.

Gunn, D.—Forecast of Areas in the Transvaal where eggs of Brown Locusts have been laid. Transv. Agric. Journ., 1908, vol. vii, pp. 81-83, 1 map.

Howard, L. O.—The importation of *Tetrastichus xanthomelaenae* (Rond.). Journ. Econ. Entom., 1908, vol. i, pp. 281-289, 1 fig.

Dr. Howard describes the steps that have been taken to introduce this parasite of the Elm leaf-beetle, *Galerucella luteola*.

Lefroy, H. M.—The Cotton Leaf-roller (*Sylepta derogata*, Fabr.). Mem. Dept. Agric. India, Entom. Ser., 1908, vol. ii, no. 6, pp. 95-110, plt. ix.

Lounsbury, Chas. P.—Report on the Scale Insect on Salisbury Kopje. Rhodesian Agric. Journ., 1908, vol. vi, pp. 32-41, 1 plt.

Lounsbury, Chas. P.—Locust Plagues in South Africa. Factors accountable for invasion. Methods of Destruction. Rhodesian Agric. Journ., 1908, vol. vi, pp. 54-68, 2 figs.

Lounsbury, Chas. P.—Melon Aphis. Agric. Journ. C.G.H., 1908, vol. xxxiii, pp. 491-496, 2 figs.

Marlatt, C. L.—The Imported Elm Leaf-beetle (*Galerucella luteola*, Müll.). U.S. Dept. Agric., Bur. of Entom., Circ. No. 8, rev. ed., 1908, pp. 1-6, 1 fig.

Parrott, P. J.—Notes on Apple Mites. Journ. Econ. Entom., 1908, vol. i, pp. 311-313.

Quale, H. J.—The California Grape Root-worm (*Adoxus obscurus*, Linn.). Agric. Exp. Stat. Berkeley, Cal., Bull. No. 195, 1908, pp. 1-28, 18 figs.

Theobald, F. V.—Report on Economic Zoology for the year ending April 1st, 1908. Pp. 119, 46 figs. London and Ashford: Headley Brothers.

Thomsen, F.—A Note on the Fumigation of Citrus Trees with Hydrocyanic Acid Gas. Transv. Agric. Journ., 1908, vol. vii, pp. 74, plt. 10.

Van Dine, D. L.—Report of the Entomologist. Ann. Rpt. Hawaii Agr. Exp. Stat. for 1907, 1908, pp. 25-51, plts. i, ii, and 3 figs.

Webster, F. M.—The Joint Worm (*Isosoma tritici*, Fitch). U.S. Dept. Agric., Bur. of Entom., Circ. No. 66, rev. ed., 1908, pp. 1-7, 6 figs.

Webster, R. L.—Saw Fly Larvae in Apples. Journ. Econ. Entom., 1908, vol. i, pp. 310, 311.

Willis, M. K.—The Brown Locust Campaigns of South Africa—Season 1907-8. Transv. Agric. Journ., 1908, vol. vii, pp. 83-89.

V.—Forestry.

VI.—Fisheries.

VII.—Medicine.

Browning-Smith, S.—Rat Destruction Operations in the Punjab. Indian Med. Gaz., 1908, pp. 283-289.

Patton, W. S.—*Cimex rotundatus*, Signoret. Indian Med. Gaz., 1908, pp. 391, 392.

Reaney, M. F., and Malcomson, G. E.—Rat Destruction in Kamptree. Indian Med. Gaz., 1908, pp. 338, 339.

Saigol, R. D.—Further Observations on the Flea-killing power of certain Chemicals. Indian Med. Gaz., 1908, pp. 289-292.

Thomas, F. G., and Parsons, J. H.—Dipterous Larva in the Anterior Chamber. Lancet, 1908 (Oct. 24), pp. 1217, 1218.

VIII.—Animal Diseases.

Robertson, W.—A New Worm in the Ostrich. Agric. Journ. C.G.H., 1908, vol. xxxiii, pp. 431, 432.

A species of *Dicheilonema* found in the body cavity.

Theiler, A.—The Inoculation of Sheep against Blue-Tongue and the results in practice. Transv. Agric. Journ., 1908, vol. vii, pp. 30-39.

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THE JOURNAL OF ECONOMIC BIOLOGY

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VOLUME IV.

1909.

LONDON:

DULAU AND CO. LTD., 37, SOHO SQUARE, W

1909.

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THE

JOURNAL OF ECONOMIC BIOLOGY.

DESCRIPTIONS AND LIFE-HISTORIES OF TWO NEW PARASITES OF THE BLACK CURRANT MITE, *ERIOPHYES RIBIS* (NAL.).

By

ADELAIDE M. TAYLOR.

(From the Zoological Laboratory, University College, Reading.)

With Plates I and II, and 5 Text Figures.

The black currant mite is a pest only too well known to cultivators of bush fruits. Its wide distribution and the rapidity with which it invades a plantation causes its appearance in the orchard to be reckoned as an inevitable commercial loss. The full details of the life-history of this mite are as yet imperfectly understood, and the pest continues to increase rapidly. This is probably due to the want of this requisite knowledge. There are numerous animal parasites which prey on the mites, among which may be mentioned the larvae of the chalcid fly, hover fly, ladybird, and many predatory acarids. The majority of these, however, are of little importance in keeping the pest in check, for they can only exercise their predatory habits during the brief period of activity allotted to insects which pass the winter months in a dormant condition. The chalcid fly is an important exception, as will be seen from the account of its life-history given in this paper.

In addition to these natural enemies the mites are parasitized by a minute fungus, a species of *Botrytis,* hitherto undescribed, and closely allied to that which attacks the silkworm (*Botrytis bassiana*). This fungus, which is most deadly in its action on the mites, makes its appearance as a parasite when the buds begin to break unnaturally, owing to the depredations of the mites within. This usually occurs in the early part of the year, by which time the mites have increased to such an extent that the embryonic leaves immediately interior to the scale leaves teem with acarids. Spores of the fungus which are blown on the mites exposed by the bursting of the bud, germinate

and fructify under suitable conditions. Rapid infection ensues among the surrounding acarids, and the disease spreads until the minute parasite has worked its way through the whole bud, killing not only the mites and their eggs, but the chalcid grub which lives among them.

A bud in which the mites have been parasitized by the fungus has a characteristic appearance. The flourlike covering due to the presence of the acarids on the embryonic leaves of a "big bud" disappears, and the grey, cottony, matted film, which takes its place, spreads over the leaves in a continuous layer. When this substance is examined with a microscope it is seen to be composed of numbers of dead mites bound together by the densely interwoven hyphae of the parasitic fungus. Many species of *Botrytis* are notorious for their facultative parasitic propensities, and an interesting feature in the life-cycle of this fungus is its power to become a saprophyte or parasite at will. The life-history of the mite renders this adaptation to circumstances compulsory.

The migratory period of the acarids takes place from April onwards, and from this time till the buds burst in the early part of the year the fungus cannot gain access to the mites through the densely adhering scale-leaves, unless indeed it is borne thither by an infected mite. For six months of the year then the fungus becomes saprophytic, living on the decaying tissues of the bud in which it had previously led a parasitic existence.

The following experiments were made to test the saprophytic nature of the fungus. The spores of a pure culture of the *Botrytis* grown on Agar were carefully dusted on the bud-leaves of trees belonging to widely different orders, and put in a moist chamber. As the leaves decayed the fungus grew vigorously and produced quantities of conidia. Mites and chalcid larvae were inoculated with these spores, and in every case they developed and succumbed to the parasitic *Botrytis*.

A description of the habits of the fungus will enable its life-history as a parasite to be more easily followed. A germinating conidium produces as growth proceeds sterile and fertile hyphae. The sterile hyphae are septate, creeping, vaguely branched, hyaline, and from 2-3μ in breadth. The fertile hyphae are erect and produce at definite intervals clusters of from three to six verticillate conidiophores (Pl. 1, fig. 3). The conidiophores are acutely pointed at the tip and each bears at its apex a cylindrical, erect, hyaline, continuous conidium, which measures from 5-8μ in length and from 1.5-2μ in breadth. When the fungus is growing

vigorously the long and fructifying branches above have a tendency to intertwine, and the resulting rope-like strands of interwoven hyphae become densely covered with powdery snow-white spores. The way in which the fungus attacks and destroys the mite is as follows: When a germinating conidium comes in contact with a mite, the germ tubes bore their way through the skin, and in most cases take a longitudinal course immediately beneath the cuticle. The fructifying sub-cutaneous hyphae produce at intervals whorls of conidiophores which are thrust through the skin of the mite. From three to six emerge in one spot, another cluster is produced at a short distance, and so on along the length of the fertile hyphae. At this stage of infection the mite is frequently alive. The explanation of this fact is that the thin skin of the acarid offers but little resistance to the exit of the conidiophores and hyphae, while the mycelium which penetrates the internal tissues is obliged to dissolve the fat bodies with which it comes in contact. It is not therefore till the ramifying hyphae have bored their way through the vital tissues that death of the mite takes place. Many of the spores abstricted from the conidiophores fall on the already infected body of the mite, where they germinate. By this means fresh centres of infection are produced, and the mite rapidly becomes a mass of short conidiophores and long fructifying hyphae, both of which give off a profusion of spores. Sterile hyphae are also produced in great quantities. (Pl. ii, fig. 7).

There are three means by which the disease is distributed among the acarids: (*a*) By the germination of spores given off by the short conidiophores. In this way acarids immediately surrounding the diseased mites become infected. (*b*) By long fructifying hyphae, which develop at close intervals from three to six whorled conidiophores, each of which produces at its apex a single conidium. By this means the spores are dispersed and the disease is spread over comparatively large areas. (*c*) Finally, the vaguely branched, sterile hyphae enter the bodies of the mites with which they come in contact and produce the closely interwoven mass of acarids and hyphae already mentioned.

The effect of the action of the fungus on the mite's body becomes very noticeable as the disease progresses. At an early stage of infection a mite, while still alive, may have conidiophores and hyphae emerging from the skin, and also in most cases the sub-cutaneous hyphae can be distinguished. Its body, however, remains transparent, and the fat-bodies intact until they are reduced by the ramifying hyphae. Subsequent disintegration

of the internal tissues is probably brought about by enzymes excreted by the hyphae, for the mite loses its transparent appearance, becomes opaque, of granular consistency and dull yellow in colour. The internal tissues contract from the cuticle, and the acarid becomes much distorted in shape. This is partly due to loss of turgidity in the cells of the body which causes the skin to collapse, and partly to the rupture of the epidermis brought about by the exit of numerous conidiophores and hyphae. When the contents of the body have been absorbed by the fungus, the interior of the mite becomes a mass of interwoven hyphae, and the exterior is covered with dense masses of conidiophores and long sterile and fertile hyphae, which entirely obliterate its outline.

Chalcid grubs are also readily infected with the disease (Pl. i, fig. 6). The following results are recorded from inoculated specimens. On the second day after inoculation there was no visible sign of the fungus; on the fourth day, however, the grub was, apparently, lifeless, and tufts of long hyphae were seen to emerge from the discoloured portions of the body. By the sixth day the grub had become a mass of flocculent hyphae, and conidia were being abstricted from the short conidiophores proceeding from the discoloured parts. On the ninth day the whole grub was much discoloured and distorted in shape, and quantities of spores were being given off from short conidiophores and long fertile hyphae. By the fourteenth day the outline of the chalcid larvae was obscured by the ropes of interwoven fructifying hyphae covered with powdery masses of spores. At the end of the experiment the fungus had also infected and killed the mites covering the "big bud" leaves on which the chalcid grubs were placed. In the control experiments the chalcid larvae were alive and healthy. In order to ascertain the length of time required by the fungus to infect all the mites in the "big buds," cuttings were inoculated with the pure culture fungus and kept under (*a*) abnormal conditions, *i.e.*, in a damp chamber at room temperature, (*b*) under normal conditions, *i.e.*, out of doors. It was found that in the cuttings kept in the open the disease had inoculated the whole colony at the end of six weeks, while those kept in the laboratory under favourable conditions to the growth of the fungus, produced the same results in about half the time. By the conclusion of the experiment the mites, their eggs and the parasitic chalcid larvae were killed, while the embryonic leaves of the buds remained green and apparently uninjured. Attempts were made, with negative results, to inoculate insects and arachnids such as surface caterpillars, grubs of the garden weevil, the common

blowfly and garden spiders. Successful results, however, followed inoculation of Nut Mites (*Eriophyes avellanae*) and Birch Mites (*Eriophyes betulae*). The fungus was sent for identification to Mr. Massee, whose technical diagnosis of the species is as follows:—

Botrytis eriophyes, Mass.

Maculae parvae, niveae. Hyphae steriles repentes, septatae, 2-3 crass vage ramosae; fertiles erectae, ramis ramulisque subverticillatis. Ramuli tenues apice acutiusculi. Conidia prope apicem ramulorum inserta, cylindracea, hyalina, continua, erecta, $5\text{-}8 \times 1.5\text{-}2\mu$.

Habit.—Parasitic on *Eriophyes ribis* (Nal.).

A minute fly belonging to the group *Chalcididae* is one of the most common and useful of the parasites which attack the mites, for it passes the greater part of the year in an active larval condition, during which time it lives between the leaves of

Fig. A.—Eggs of *Chalcid.* One is showing the segmentation of future larva.

the "big-bud" and depends solely on the mites for its means of subsistence. It is to be expected that the presence of this predaceous larva would help to diminish the number of mites in a "big bud." Numerically the mites must decrease by this constant parasitism, but their loss is so little felt among the thousands present that there is no apparent lessening of their numbers, nor is the "big bud" perceptibly smaller than those which contain no parasite. The habits of the larva too are such that comparatively little food is required by them. When it is considered that the larval stage is passed between the leaves of a bud, and that they are surrounded by more food than they can consume, it is not surprising to find them extremely lethargic, their reason for activity being removed. The number of mites therefore consumed by the grub is proportionately small, for only sufficient nourishment is taken to replace the waste of the body due to activity and growth.

The life-history of this parasite is simple. The perfect insects appear in May and live for the space of two or three weeks. The female fly selects for the purpose of depositing

the egg those buds which contain the necessary food for the future larva. The female fly is provided with a long ovipositor with which it pierces the "big bud" which is in process of development. The aperture thus made is of sufficient length to enable the egg to be placed near or in the centre of the young bud, where the newly-arrived mites congregate. The egg is distinctly stalked, transparent, colourless and has a dull shiny appearance (Fig. A). Usually one, sometimes two, are deposited in one bud among the mites. Through the transparent shell of the developing egg the process of segmentation can be followed, and after a period of three weeks the larva emerges as a legless worm-like grub, consisting of a head and thirteen body segments. The head is retractile, and the

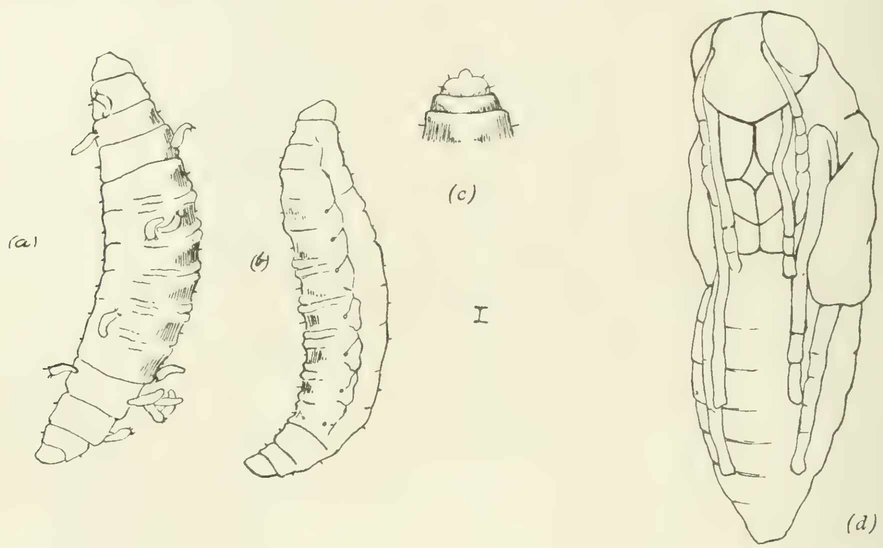


Fig. B.—(*a*) Larva of *Chalcid* over which the mites are crawling. (*b*) Larva of *Chalcid* showing trachael system. (*c*) Head of larva much enlarged. (*d*) Pupa of *Chalcid*.

organs of sight are undeveloped. The segments of the body are more or less well defined, and sparsely provided with setae, used by the grub as a means of locomotion. The larva has a transparent skin, through which the internal organs are seen, the colour of the body being greyish-white, except in the parts surrounding the alimentary canal, where a dull yellow tone predominates. When a grub is removed from its natural surroundings in a "big bud," it is covered with numbers of mites, which adhere to and crawl over its body (Fig. B *a*). The adhesion of the mites to the larva is apparently due to a sticky substance which is exuded from its skin. When occa-

sion demands, the grub can exhibit considerable powers of movement. In order to progress it must contract and arch the body, the posterior part is thus brought in contact with the anterior, the former is then

Fig. C.—Imago.

fixed and the latter moved forward, after which the process is repeated. The grub requires nine months to complete its growth, and by April the pupal stage is reached. The metamorphosis takes place within the bud which has now dried up, and from which the mites are in an active state of migration. Through the transparent pupal skin one sees that the fly is brown, that the wing-buds are prominent, and that the legs and antennae are not soldered to the body. In May the pupal skin is cast, and the perfect fly emerges

(a) (b) (c)

Fig. D.—(*a*) Antenna. (*b*) Tarsus. (*c*) Last Tarsus, showing pad.

to creep out from beneath the shrivelled leaves of the bud. The fly itself is a beautiful little insect, with large wings folded one across the other in the manner typical of the group. It possesses

considerable powers of flight, but usually prefers to move in a succession of short jumps, which is also a characteristic feature of the family *Chalcididae*. The whole body of the insect is more or less hairy and brown in colour. When alive the eyes are a brilliant red, and the division of the thorax, the scutellum, and occipital patch are outlined with yellow. After death the insect loses this vivid colouring and becomes almost uniformly brown. The venation of the wings is simple; a single definite nervure runs along the costal margin of the anterior wing, giving off at its termination a short vein thickened at the end. The posterior pair is much narrower and slightly veined along the costal margin. The wings are transparent, iridescent and densely covered with hairs, which give them the appearance of being fringed at the margins. The head is comparatively large, the eyes well developed, the antennae six jointed, setaceous, and the terminal joint clavate. The legs are long, slender, and covered with hairs, the tarsus is four jointed and terminates in a pad. Nine segments are visible in the abdomen, and in the female an ovipositor is present.

Mr. J. C. Crawford has, in the absence of Dr. Howard, of the Entomological Department, Washington, kindly identified the chalcid as a species of *Tetrastichus,* to which I give the name *Tetrastichus eriophyes*.

The expenses of this research were defrayed by a grant from the Research Fund of the University College, Reading.

EXPLANATION OF PLATES I AND II.

Illustrating Miss Adelaide M. Taylor's paper on the " Description and Life-histories of Two New Parasites of the Black Currant Mite, *Eriophyes ribis* (Nal.)."

Plate I.

1.—Conidia germinating.

2.—Egg of Mite attacked by the fungus *Botrytis eriophyes*, Mass.

3.—Conidiophore of the fungus grown on Agar.

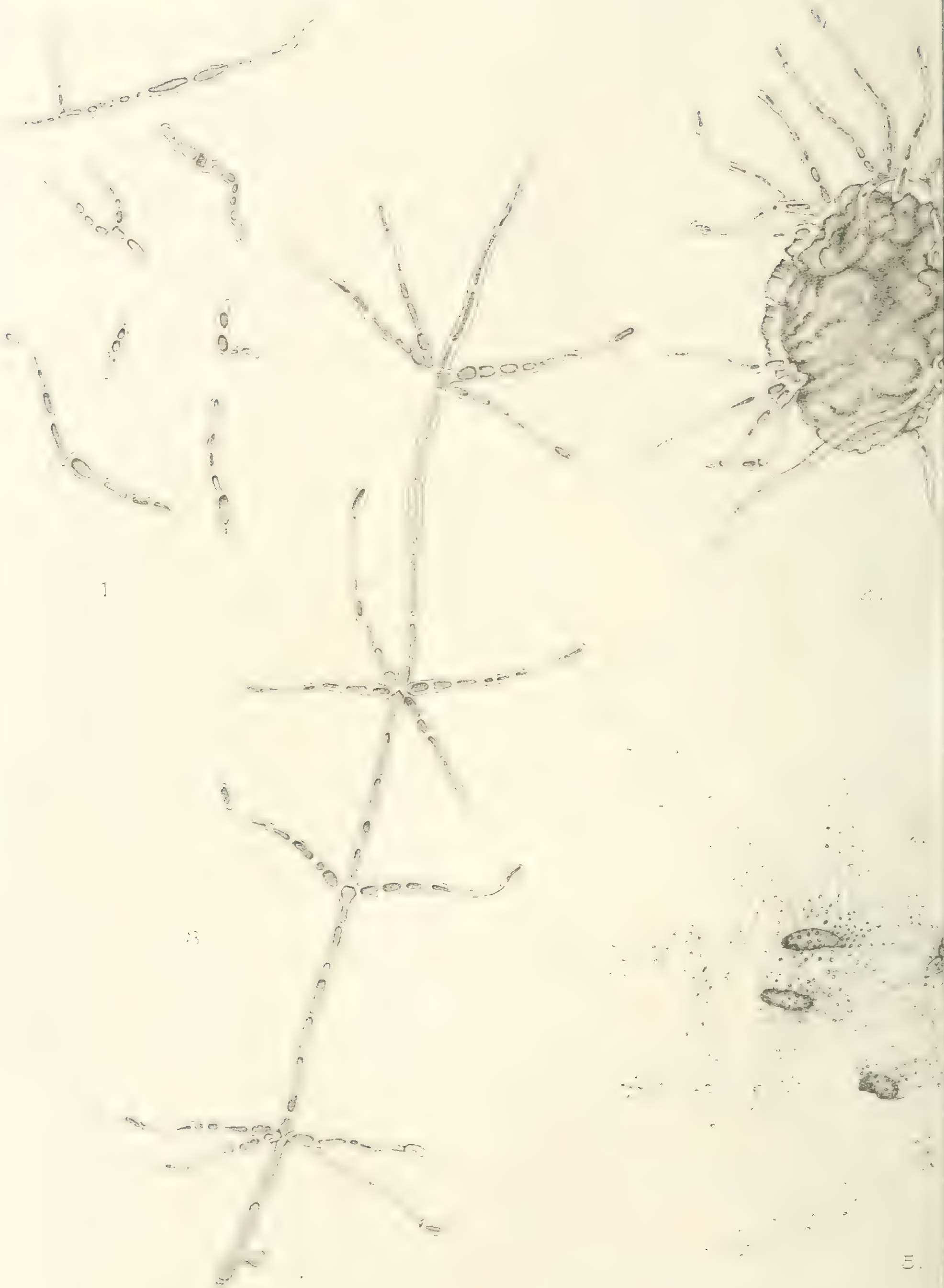
4.—Intertwining of conidiophores to form rope-like strands of fructifying hyphae.

5.—Mites attacked by the fungus.

6.—Chalcid grub attacked by the same.

Plate II.

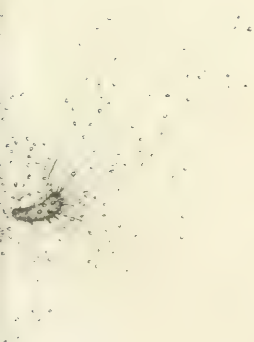
7.—Group of mites attacked by the fungus, much enlarged.



BOTRYTIS ER

Pl. I.

4



6

PHYES. Mass.

Huth, Lith. London.

7.

BOTRYTIS

DESCRIPTIONS OF TWO NEW SPECIES OF COLLEMBOLA.

By

WALTER E. COLLINGE, M.Sc., F.L.S., F.E.S.,

AND

JOHN W. SHOEBOTHAM, N.D.A.

With Plate III.

The two species of Collembola here described are both of interest in that we believe one of them to have hitherto been referred to a well-known species, whilst the other we do not think has previously been recognised.

One, a species of *Sminthurus*, has been obtained by us in great abundance in several greenhouses and conservatories in the neighbourhood of Berkhamsted, in connection with our work on the Collembola and Thysanura of Hertfordshire; whilst the other, a species of *Papirius*, Lubb., was collected by Mr. R. G. Sims in Worcestershire, and is referred to in the account of the "Collembola and Thysanura of the Midland Plateau," written by one of us (3).

Sminthurus biflavopunctatus, n.sp.

Pl. III, figs. 1-7.

Body, dorsally dark brown, ventrally and legs yellowish-brown, with a pair of prominent yellow patches situated posteriorly and dorso-laterally on slightly raised prominences. Few scattered hairs. The whole of the cuticle is finely granulated (Pl. iii, fig. 4). Eye spot, with seven ocelli (Pl. iii, fig. 3). Antenna hairy, four-jointed, the distal segment being the largest, and terminating in a blunt end, on which is an antennal organ. Furcula somewhat broader than in *S. aureus*, with mucrones more spatulate, edges dentate. Feet, upper claw without a tooth, simple, under claw blade-like, no tenent hairs. Length, .57 millim.

Hab.—Berkhamsted.

This is an exceedingly active little species, running about rapidly, moving its antennae in short sudden quiverings. The usual habitat is around the underside of the lip of flower-pots.

Some of the specimens when found were submitted to Professor

[Journ. Econ. Biol., 1909, vol. iv, No. 1.]

Geo. H. Carpenter, who very kindly examined the same and expressed the view that they belonged to the var. *bimaculata*, of *Sminthurinus aureus*, Lubb., described by Dr. Axelson in 1902; from this view, however, we are forced, as a result of more minute examination, to differ.

On referring to Dr. Axelson's paper (1) we find that he described the var. *bimaculata* as a new variety of *Sminthurinus igniceps* (Reut.), but queried the species.

He states (*op. cit.* p. 110) "Grundfarbe schwarz, an den Seiten des Körpers ein grosser, gelber oder gelblichweisser, fast kreisrunder Fleck, welcher sich bei einigen Exmplaren nach unten erstreckt, mit der gelben Farbe am unteren Teile des Körpers zusammenfliessend. Das letzte Abdominalsegment und Furca sowie die Oberseite des Kopfes ausser den schwarzen Augenflecken gelb oder gelbweiss. Gelbbraunes Pigment findet sich an den Seiten des Kopfes. Ein kleiner schwarzer Fleck ist auf der Vorderseite des Kopfes oft wahezunehmen. Länge nur O, 4—O, 5 mm."

Our specimens differ from the above description in colour and markings, the large yellow spots never reaching underneath the body, whilst the general shape of the body is very distinct from that of *S. igniceps* (6, p. 22, T. i, figs. 2-2*b*).

According to Dr. Reuter's drawing (6, fig. 2), the terminal segment of the antennae is sharply pointed, whereas in our species it terminates bluntly, and has a minute bead-like antennal organ at the extreme end (Pl. iii, fig. 5 *a. o*). The foot of *S. igniceps* is also very distinct from the form obtaining in this species (cf. Reuter T. i, fig. 2*b*).

Dr. Axelson points out that it is difficult to determine whether the var. *bimaculata* represents a characteristic form or only a variety. The *S. igniceps* of Reuter he observes is, in Finland, a typical hot-house species, whereas this variety is found by the side of ditches or streams, and is noticeably smaller.

After satisfying ourselves that the form we had was distinct from *S. igniceps* (Reuter), we next compared it with examples of *S. aureus*. Lubbock's figures (5, pl. 7) agrees with examples of that species we have in our collection. The general outline and contour of the body, as also the size and minor details in the form of the ocelli (see Guthrie, 4, pl. xviii, fig. 8), are all quite distinct from the specimens here described.

Curious to say in the localities where these specimens were found we have been unable to find any that could be referred to either

Sminthurus aureus, Lubb., or *Sminthurinus igniceps* (Reuter), although the former species is by no means uncommon in this neighbourhood.

Papirius carpenteri, n.sp.

Pl. III, figs. 8-12.

Body globular, with a few scattered hairs. Colour dorsally mottled, with a deep blackish-brown and yellow. Anal segment spotted with yellow. The antenna consists of four segments, and is characterised by its roughened knobbed form, and the division of the two distal segments into a number of separate joints. The first segment is the shortest, a mere stump-like body; the second is long and marked with a number of irregular knobs; the third, the longest of the four, consist of an unjointed proximal portion and a five-jointed distal portion, the distal division terminating in a broad, knobbed, club-like head, with four prominent blunt spikes, which project beyond the segment; the fourth segment consists of five divisions; the first being the largest, and occupying more than half of the segment. All the divisions are characterised by their roughened surface and a series of somewhat spirally arranged bosses or studs (Pl. iii, fig. 9).

The whole of the segments are covered with scattered hairs, but these are not arranged in whorls, as in some species of the Genus. Eye spot with eight ocelli, six large ones and two smaller ones (Pl. iii, fig. 11). The feet are very characteristic; each terminates in two claws, the upper of which is stout and curved, terminating bluntly with a small finger-like protuberance on the inner side (*f*). Near to its proximal end, and on the dorsal side, is a well-marked tooth-like spine (*sp*.). The lower claw is flat, blade-like, and somewhat triangular in shape, it is produced in its inner side into a short spine (*s. sp*.), and the same condition obtains at its extreme distal end. Just before this latter is a long hair-like spine on the inner side (*h. sp*.). The blade is raised in the median line (*m.l.*), this raised portion arising from a prominent boss or ridge at the proximal end (*b*). The claws articulate upon a trapezoid-like segment (*t. sg*.). There is no tooth on the inner margin of the upper claw, as is present in *P. ornatus*. The mucro (Pl. iii, fig. 12) is somewhat elongated, and has the edges closely dentated, the teeth being blunt. Length, 1.2 millim.

Hab.—Abberley, near Stourport (R. G. Sims).

Under pieces of decaying branches and pieces of wood close to the side of a stream.

We have pleasure in associating with this species the name of

Professor Geo. H. Carpenter, whose investigations have added so largely to our knowledge of this interesting Order of insects.

P. carpenteri finds its nearest relationship with *P. ornatus* (Nic.), Lubb., but differs from that species as described and figured by Lubbock (5), and also Carpenter and Evans (2), in the form of the antennae, the mucrones, the ocelli, and the form of the feet.

We have examined a large number of specimens of *P. ornatus*, all of which agree pretty closely with Lubbock's figures. In no case have we found the terminal segment of the antenna jointed, nor do the other segments agree at all with the condition which obtains in *P. carpenteri*.

The possibility of this species being referable to Bourlet's genus *Dicyrtoma* has occurred to us, but being unacquainted with any of the species of that genus and unable to refer to any of the figures, we are not able to offer any opinion.

BIBLIOGRAPHY.

1.—Axelson, Walter M.—Diagnosen neuer Collembolen aus Finland und angrenzenden Teilen des nordwestlichen Russlands. Meddel. Soc. Fauna et Flora Fennica, 1902, pp. 101-111.

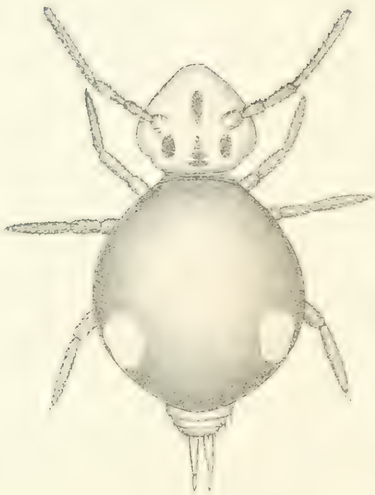
2.—Carpenter, G. H., and Evans, W.—The Collembola and Thysanura of the Edinburgh District. Proc. Roy. Phys. Soc. Edinb., 1889, vol. xiv, pp. 221-266, plts. v-viii.

3.—Collinge, Walter E.—The Collembola and Thysanura of the Midland Plateau. In the Press.

4.—Guthrie, J. E.—Studies of the Collembolan Eye. Proc. Acad. of Sciences, Iowa, 1907, pp. 239-243, plt. xviii.

5.—Lubbock, J.—Monograph of the Collembola and Thysanura. Ray Soc., 1873, pp. 1-276, 78 plts.

6.—Reuter, O. M.—Collembola in caldariis viventia enumeravit novasque species descripsit. Meddel. Soc. Fauna et Flora Fennica, 1890, Bd. xvii, pp. 17-28, Tab. i.



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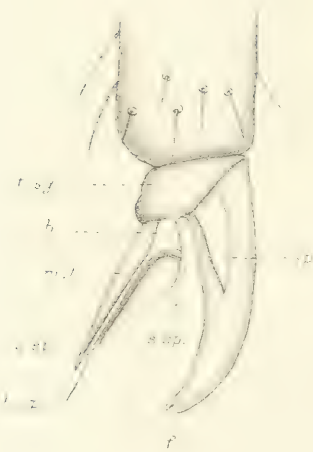

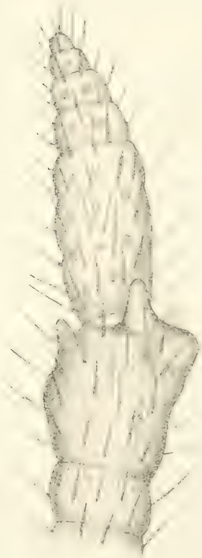

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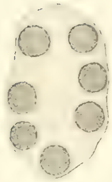

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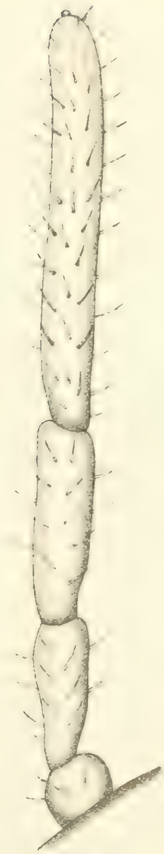

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MBOLA.

EXPLANATION OF PLATE III.

Illustrating Messrs. Collinge and Shoebotham's paper on "Two New Species of Collembola."

Fig. 1.—*Sminthurus biflavopunctatus*, n.sp.		
Fig. 2.—*Sminthurus aureus*, Lubb.		Copied from Lubbock's Monograph.
Fig. 3.—*Sminthurus biflavopunctatus*, n.sp.		Left Eye spot.
Fig. 4.—	,, ,,	Portion of integument.
Fig. 5.—	,, ,,	Antenna.
Fig. 6.—	,, ,,	Foot of the 3rd leg.
Fig. 7.—	,, ,,	Mucro.
Fig. 8.—*Papirius carpenteri*, n.sp.		Lateral view of the antenna.
Fig. 9.—	,, ,,	Terminal portion of the same seen from below.
Fig. 10.—	,, ,,	Foot of the 3rd leg.
Fig. 11.—	,, ,,	Left Eye spot.
Fig. 12.—	,, ,,	Mucro.

Reference Letters.

a.o.—Antennal organ.	*m.l.*—Median Line.
b.—Boss.	*s.p.*—Spine.
f.—Finger-like process.	*s.sp.*—Small Spine.
h.sp.—Hair-like spine.	*t.sg.*—Trapezoid-like segment.

All the figures are drawn with the aid of a Leitz Drawing Eyepiece.

OBSERVATIONS ON THE LIFE-HISTORY AND HABITS OF *THEREVA NOBILITATA*, FABR., AND OTHER SPECIES.

By

WALTER E. COLLINGE, M.Sc., F.L.S., F.E.S.,

Berkhamsted.

With Plate IV.

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2. External Form and Habits of the Larva	15	5. Systematic	17
3. The Pupa	16	Explanation of Plate	18

1.—Introduction.

The Genus *Thereva* was erected by Latreille in 1796 for a number of medium-sized flies, occurring, in this country, mostly in small plantations, thickets, orchards, and on the outskirts of woods. Generally speaking, they prefer dry, sandy soils.

Verrall[1] catalogues six British species, one of which is doubtful, and in his Monograph[2] enumerates eight species.

Sharp[3] states that "we have about ten species in Britain, and there are some two hundred known from all the world. But little is known as to the metamorphoses."

All the species have a more or less economic value, and during the past few years a large number of the larvae and imagines have passed through my hands.

Beyond the actual descriptions of the imagines there is little literature bearing upon the larvae, pupae, and life-history of the different species.

Lundbeck[4] gives perhaps the longest notice of the larvae and pupae and their habitat.

Washburn,[5] in his account of the Diptera of Minnesota, states: "The family is a small one, predaceous in the adult and larval forms

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[1] List of British Diptera, 2nd ed. Cambridge: 1901.

[2] British Flies. London: 1909, vol. v.

[3] Insects. Cambridge Nat. Hist., pt. ii, p. 484.

[4] Diptera Danica. Copenhagen: 1908. Pt. ii.

[5] Tenth Annual Report State Entom, of Minn., 1905.

[Journ. Econ. Biol., 1909, vol. iv, No. 1]

upon insects in the young stage, probably feeding upon vegetable matter also."

Where not otherwise stated, the following remarks apply to *T. nobilitata,* Fabr.

2.—The External Form and Habits of the Larva.

The larva (Pl. iv, fig. 1) is elongate, vermiform, cylindrical, and pointed at each end; in colour a semi-transparent greenish-white, with more opaque white markings dorsally. There are apparently twenty segments excluding the head, although only thirteen true ones. The head (Pl. iv, fig. 2) is small, chitinised, and of a deep brown, and carries short antennal papillae; eyes absent. There are a pair of latero-ventral bristles on each of the three thoracic segments. Each of the first six abdominal segments appear as two segments, particularly so when viewed from the dorsal side, and the first seven have on their ventral side a series of punctiform muscular impressions.

On the eighth abdominal segment there are a pair of posterior spiracles situated on the antero-lateral portion of the segment, and a pair on the prothorax; Dr. Sharp[1] figures these on the mesothorax, cf. p. 38, fig. 65. It is only fair to mention that the specimen figured by Dr. Sharp was a very young one, taken from the roots of a currant bush at Sutton Coldfield. The last segment is the only one that exhibits any marked modification. Firstly, it is perfectly divided into an apical and a posterior portion, the latter terminating in two small styliform bodies (Pl. iv, fig. 3). There are six bristles, arranged dorso-laterally, laterally, and ventro-laterally. The anal aperture opens on the ventral surface between and slightly anterior to the styliform bodies.

The larvae prefer compact but sandy soils, in which they move about very actively. In wet and sticky soil they make use of the burrows formed by earthworms, and it was noticeable that, under these conditions, they invariably formed a small chamber off one of the burrows. In one case one was noticed feeding upon a small earthworm. Out of the soil they move by a series of jerks in a somewhat serpentine fashion. When laid on the surface of the soil they very soon made their way beneath the surface, usually remaining four to six inches below; in wet, or sticky soil, they were found much deeper, travelling, in all probability, by means of the burrows of earthworms.

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[1] Verrall, British Flies, 1909, vol. v.

The first example I received was collected on November 23rd, 1906, by Mr. R. Welch, of Sutton Coldfield, which he found at the roots of currant trees.

On December 3rd, 1906, he forwarded five more examples all of which were placed in the jar containing the specimen previously sent. Five days later only one specimen was found, it being concluded that the first specimen had eaten the others. Since then many more examples have been received from various nursery gardeners near to Birmingham and elsewhere.

Mr. Welch states that he has found them in the districts of Wylde Green, Sutton, and Four Oaks, and has usually found solitary ones, and in sandy or light soil. Sometimes at the roots of pinks and violas.

Mr. Welch speaks of the specimens forwarded as white ones, but earlier in the season he noticed specimens marked with black bands, probably another species.

The imago appeared on April 3rd, 1907. Since then many other examples have been reared from the larvae.

The larva mentioned above was kept alive until March 4th, 1907, when it pupated; it was fed on the larvae of *Ceuthorhynchus sulcicollis,* Gyll., one of which was sufficient for three or four days' food supply. Some tiny larvae of a small dipterous fly were also fed to some specimens, but they much preferred the less active weevil larvae. Others were fed on very small earthworms. Sharp mentions that the larvae of some species have been recorded as feeding upon the dead pupae or larvae of Lepidoptera.

Beling[1] records finding the larvae and pupae of *T. oculata,* in cow dung, and Westwood[2] mentions having found the larva of an undetermined species which attacked the pupae of *Alencis pictaria* and *Sphinx ligustri*; other observers have described them as being bred from Lepidopterous larvae.

I can find no mention of the eggs, what they are like, or when and where deposited.

3.—The Pupa.

The Pupa (Pl. iv, fig. 4) is shorter and considerably broader than the larva. At first it is a light yellow in colour, but with the thickening of the cuticle it soon changes to a yellowish-brown or light chocolate-brown. It is not enclosed in the larval skin, but free.

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[1] Arch. für Naturgesch., 1875.

[2] Proc. Entom. Soc. Lond., 1859, p. 59.

In all cases the pupae were found on the *surface of the soil* or only partially covered by it.

The antennal sheaths lie on the front side of the head, directed to each side; at the base of the wing sheath is a turbercle, which terminates as a fine spine. On each side of the thorax is a thin, blunt spine. The abdominal segments are partially girdled by bristles with intervening short spines from the hinder margin; dorsally there is a band extending from side to side, but that on the ventral side does not extend to the lateral edge of the segment; laterally there is a tuft of better developed spines and antero-laterally a slight protuberance which also carries the spiracle. The first segment has only a single bristle laterally. There are a pair of prothoracic and seven pairs of abdominal spiracles; the last segment terminates in a long, dark brown, attenuated bifid spine.

Length, 13 millim.

4.—The Imago and its Habits.

The imago is a medium-sized fly, and locally common on the outskirts of woods, in small plantations, thickets, orchards, etc. Generally speaking, *T. nobilitata* prefers dry, sandy soils.

Although generally considered as predaceous, I have not been able to find any evidence for such, although the fact that the flies are usually found sitting on leaves as if watching for prey would seem to lend credence to such a view. In confinement the flies soon died, most at the end of the fourth day; in one case, however, two examples were kept alive twelve days. Although kept in a large glass case they were seldom seen to fly properly, their movements consisting of a short hop-like flight of a few inches distance, and then walking very slowly. Specimens watched for forty-five minutes made practically no movement whatever, and when examined some five hours later were found exactly in the same position.

5.—Systematic.

The species I have bred are *T. nobilitata, T. plebeia, T. funebris,* and *T. annulata.*

Some difference of opinion exists as to the specific distinctness of *T. plebeia.* Mr. Verrall[1] thinks it possible that an unrecognised species exists between *T. plebeia* and *T. bipunctata,* a view with which I concur; at the same time I think there is a distinct variety of *T. nobilitata* which approaches very closely some male forms of *T. plebeia.*

[1] British Flies, vol. v.

I have frequently met with two species in copulation, also *T. annulata* and *T. plebeia*. Mr. Verrall records similar occurrences.

Lundbeck ([1], p. 133) states that he is unacquainted with any case of parasitic Hymenoptera on Therevids, and in the scores of examples I have bred out no parasitic insect has been observed.

The larvae also seem to be particularly free from the attacks of other ground larvae.

EXPLANATION OF PLATE IV.

Illustrating Mr. Collinge's paper on "Observations on the Life-History and Habits of *Thereva nobilitata*, Fabr., and other species."

Fig. 1.—Larva. × 2.

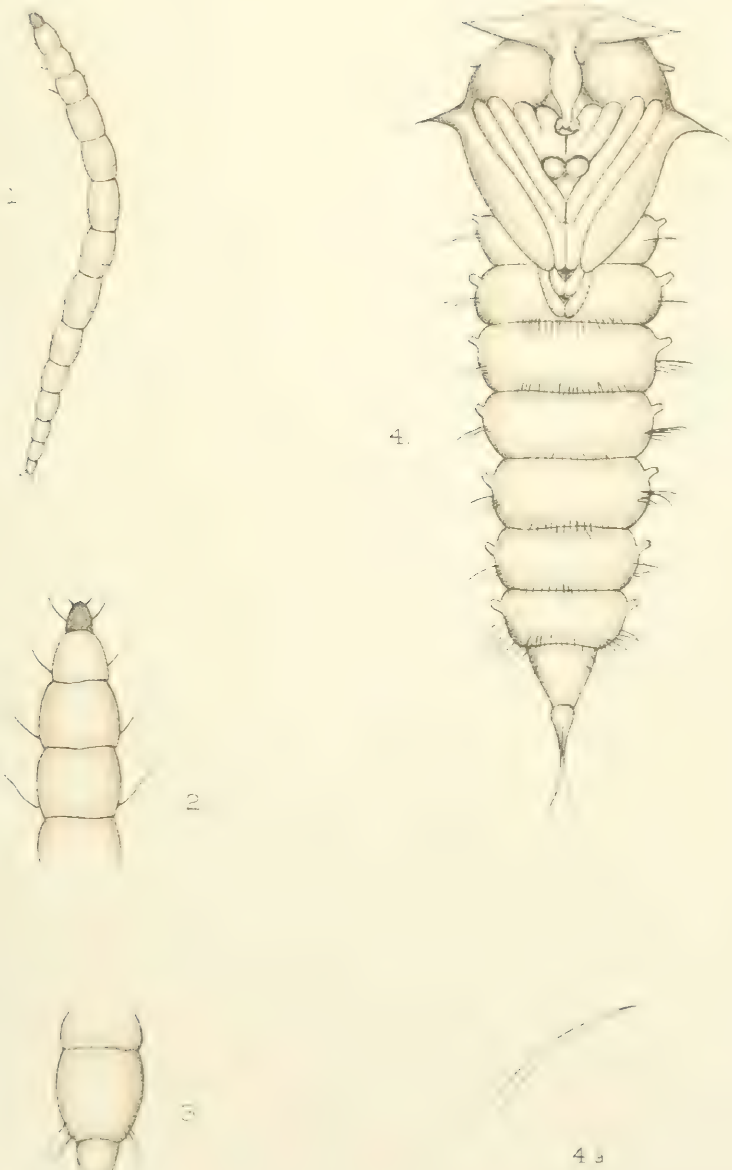
Fig. 2.—Head and thoracic segments of the same enlarged.

Fig. 3.—Last abdominal segment, showing styliform bodies and bristles.

Fig. 4.—Pupa from the ventral side. × 8.

Fig. 4a.—One of the lateral bristles enlarged.

[1] *Tom. cit.*



THEREVA NOBILITATA, Fabr.

NOTE.

Note re Rat Parasites.

Since publishing my article on the Parasites of Rats, Mr. William Evans, of Morningside Park, Edinburgh, has drawn my attention to the fact that he has collected both male and female specimens of *Typhlopsylla agyrtes,* Heller, from off *Mus decumanus,* taken at Drem, Haddingtonshire. This is recorded in his Paper on Siphonaptera in the "Annals of Scottish Natural History," 1905, p. 162. I regret I overlooked this reference when preparing my paper on Rats and their Parasites.

A. E. SHIPLEY.

REVIEWS.

Board of Agriculture and Fisheries Leaflets. Revised series. Nos. 1-12. London: The Board of Agriculture and Fisheries, 1908.

We have before us a volume containing the first hundred of the Leaflets of the Board of Agriculture, also 12 Sectional Volumes containing Leaflets 1-200. Indices have been added, and various Leaflets have revised.

In this sectional form and indexed, the various volumes must prove considerably more useful and easier of reference.

In looking through very many of the Leaflets one regrets that the Board have not submitted them to specialists, and also that it is not provided with better financial assistance, whereby these could have been produced in a style at least equal to that of the Farmer's Bulletins of the U.S. Department of Agriculture.

W. E. C.

Depéret, Charles.—The Transformations of the Animal World. Pp. xvi + 360. London, Kegan Paul, Trench, Trübner and Co., Ltd., 1909. Price 5s.

At a time when many students are approaching the study of animal evolution for the first time, the appearance of an English translation of this well-known work is most opportune.

In chronological order the author sets forth the historical development of ideas, the work of the earlier investigators such as Cuvier,

Buffon, Goethe, and Oken, and that of the later workers such as Lamarck, Darwin, and Haeckel.

Turning next to the evolutionary ideas in palaentology he traces the advances made by Neumayr, Cope, Gaudry, and von Zittel, and discusses the laws of palaentology; the causes of the extinction of species; the mechanism of the production of new forms; and the action of migrations.

The book is full of interest to both palaentologist and geologist, but the absence of any references to literature, and the revision of the translation by some competent biologist, are two very serious drawbacks to an otherwise technical, but very interesting work.

W. E. C.

Gaskell, W. H.—The Origin of Vertebrates. Pp. ix + 537, 168 figs. London: Longmans, Green and Co., 1908. Price 21s. net.

In his introduction Dr. Gaskell points out that during the twenty years in which he has published the papers from which the present work is compiled, his theory of the origin of vertebrates has been ignored by the morphological world as a whole rather than criticized, and he has been led to put his conclusions into book-form with the hope that those who differ from him will come forward and show him where he is wrong, and why his theory is untenable.

Personally we very much doubt whether this battle royal will ever take place, for so many theories as to the origin of vertebrates have been put forward, all equally tenable (and equally futile) that most zoologists are tired of these one-sided, narrow-grooved views, and are content to leave the matter alone.

Provided we grant certain premises, Dr. Gaskell's theory is equally sound with any that have gone before, but, it is just these premises which are the stumbling block.

Briefly the author endeavours to prove that vertebrates are derived directly from arthropods, that the arthropodean alimentary canal is represented by the ventricles of the brain and the central canal of the spinal cord, the pituitary body and embryonic pharynx represent the mouth of the arthropod, and the neurenteric canal the primitive anus. The different parts of the central nervous system of the arthropod are shown to have given rise to those of the vertebrate brain, and so on. Ammocoetes, the larval lamprey replaces our much tried friend Amphioxus as the nearest living representative of the early fish-like vertebrates, and the chain of succession is gradually built up.

The book is indeed a brilliant piece of patient deductive work, and will be read with interest by those who take an interest in such theories.

W. E. C.

Lankester, Ray.—A Treatise on Zoology. Part I. Introduction and Protozoa. First fascicle by S. J. Hickson, J. J. Lister, F. W. Gamble, A. Willey, H. M. Woodcock, the late W. F. R. Weldon, and E. Ray Lankester. Pp. xiv + 296, 151 figs. London: Adam and Charles Black, 1909. Price 15s. net.

In the few lines in which Sir E. Ray Lankester prefaces this volume, he points out that the two fascicles of the first part of this treatise give a more complete account of the Protozoa than is to be found in any similar work hitherto published, and he might very justly have added, written and edited in a style seldom if ever surpassed.

The present fascicle opens with an Introduction by the Editor, in which he briefly and lucidly discusses (*a*) the dividing-line between plants and animals, (*b*) the separation of the Grade Protozoa from the Grade Metazoa, and (*c*) the separation of the Classes of Protozoa into Grades of lower and higher structure.

Of the different Sections we cannot pretend to criticise. All have been placed in the hands of acknowledged authorities, and are admirable in detail and as concise as is consistent with lucidity. The two volumes must prove invaluable to all students of the Protozoa, replete as they are with the fullest information and full bibliographic references, and at the same time indispensable to all zoologists.

W. E. C.

Lundbeck, William.—Diptera Danica. Genera and Species of Flies hitherto found in Denmark. Pt. I. Pp. 166 and 47 figs. and 1 portr. Pt. II., pp. 160 and 48 figs. Copenhagen: G. E. C. Gad. London: William Wesley and Son, 1907, 1908.

Amongst the few really important monographs of the Diptera, Professor Lundbeck's "Diptera Danica" will take a prominent position, and the fact that it is written in English will appeal to a large circle of dipterologists.

The author has followed Brauer in the classification, and commences with the Orthorrhapha brachycera.

Part I. treats of the *Stratiomyiidae, Xylophagidae, Coenomyiidae, Tabanidae, Leptididae,* and *Acroceridae;* and Part II. with the *Asilidae, Bombyliidae, Therevidae,* and *Scenopinidae.*

After briefly reviewing the earlier writings on Danish Diptera, a short account is given of the terminology used in the work, followed by some notes on the nature of the localities.

Turning to the systematic portion we find the diagnoses clear and detailed, at once indicating the author to be thoroughly conversant with his subject, and whilst we welcome the admirable word-portraits of the different genera and species, we are doubly grateful for the excellent accounts that are given of the egg, larva, and pupa; their place of deposition, habitat, habits, etc.

Indeed, if the author had not done more than present us with the careful descriptions of the larvae, they would be sufficient in themselves to constitute a most useful work of more than ordinary value to the student of the Diptera. In few Orders of Insects are the larvae of more interest and importance than in this one, and it is the exception to find more than a passing reference to them in the chief monographs.

We look forward to the early appearance of future parts of this work, which, when complete, must take a high rank amongst dipterological literature, and one that no student of the Order can afford to be without.

The two parts before us are well printed, and the illustrations, although few, are well reproduced.

W. E. C.

Newstead, R.—The Food of Some British Birds. Suppl. to Journ. Board Agric., 1908, vol. xv, pp. viii + 87. Price 4d.

For many years a controversy has raged as to the economic value of certain British wild birds, but the difficulty one has always had to face has been the absence of any careful and systematic details giving the crop and stomach contents of the species under discussion. In the absence of such it has been impossible to come to any satisfactory or practical conclusions.

Mr. Newstead's list enumerates no less than 871 post-mortem examinations of the stomach contents and the "pellets" or "castings" of 128 British birds. Of many of these there has never been any doubt as to their beneficial influence, and whilst we heartily welcome the author's memoir as an excellent piece of work, its value is considerably lessened by the fact that of the really doubtful species only a few post-mortems have been made: thus of the Blackbird 12, Greenfinch 11, Chaffinch 27, Bullfinch 26, Magpie 8, Jackdaw 11, Rook 14, Starling 16.

Any conclusions based on so small a number of post-mortems can only be of partial value, for the information desired is the nature of the food in different localities, based on stomach-content examinations throughout the whole of the year. The recently appointed Ornithological Committee of the British Association will no doubt ultimately provide this much desired information. In the meantime, Mr. Newstead's interesting memoir affords much material for thoughtful reflection and study.

W. E. C.

Nuttall, G. H. F., Warburton, C., aided by Cooper, W. F., and Robinson, L. E.—Ticks: a Monograph of the Ixodoidea. Pt. I. *Argasidae*. Pp. x + 104 + 35, 3 plts. and 114 figs. Cambridge: University Press, 1908. Price 5s. net.

The authors' prefatory note states, "the discovery of the economic importance of ticks as carriers of disease to man and domesticated animals

has led to a vast increase of our knowledge of this group. No existing work in any language attempts to deal with the subject in a comprehensive manner . . . there is therefore urgent need for a work of the nature here attempted."

In the part before us an excellent account is given of the *Argasidae,* and much labour seems to have been expended upon the classification and literature. We had hoped that a full account of the anatomy would have prefaced each Family and Genus, but the authors promise an adequate introduction at a later date.

It is not too much to say that no one interested in the study of *Ixodoidae* can afford to be without this work, which is well printed and illustrated.

Whilst fully cognisant of all the good features to which we would give the fullest praise, we cannot overlook the fact that there are, in our opinion, some unnecessary weak ones.

One of the most striking is the waste of space under the headings synonymy, iconography, and literature. The laboured manner in which they have been compiled and the often needless comments interspersed, might well have been dispensed with.

Hitherto in most, if not all, systematic works of this character, it has been possible to refer to the source of the original description and synonymy of a species with the least possible trouble. In the work before us the reference is omitted, and one has to turn to the Bibliography of about 300 titles to hunt for each one required. Such a method is known as the Havard system, and we hope it will be a long time before we meet with it again.

Another point to which we take objection is the manner in which the authors use the figures of others, acknowledging them as follows: (Nn. 1896, fig. 27), surely it is as little as the borrowers can do to state "After Neumann," or "Neumann, 1896, fig. 27," particularly so after the note on p. vi, in which their own respective work is so vigilantly guarded.

W. E. C.

Stebbing, E. P.—A Manual of Elementary Forest Zoology for India. Pp. xxiii + 230 + xxxiv, 422 figs. Calcutta: Superintendent Government Printing, 1908. Price 15s.

Mr. Stebbing may be congratulated on having realised and produced the nearest approach to a text-book on Economic Zoology we have yet seen, although the author lays no claim to its being more than an elementary manual of forest zoology.

The work covers the whole animal classification, but throughout prominence is given to the economic side.

The most important section is undoubtedly that treating of the Insecta and the numerous careful and detailed life-histories, profusely illustrated,

bear testimony to the valuable work the author has done and is doing. The economic importance of entomology to Indian forestry is fully realized, and Mr. Stebbing seems to have lost no opportunity of impressing the importance of the subject upon his readers.

Whilst according unqualified praise to the section devoted to the Insecta, we are equally pleased with the manner in which the fishes and birds have been treated, particularly the latter.

The book will be found of great value not only to Indian foresters, but to all who desire a fuller knowledge of Economic Zoology.

We heartily congratulate the author on his work, but much regret the style in which it has been produced. The wretched poor paper has marred the text, and the absence of proper plate paper has, with a few exceptions (*e.g.*, figs. 193, 194, 259, 261, 313, and 314) spoilt the illustrations. With better paper most of the figures might, with advantage, have been included in the text.

W. E. C.

Verrall, G. H.—British Flies. Vol. v, pp. iii + 780 + 34, 406 figs. London: Gurney and Jackson. Price £1 11s. 6d.

We are pleased to welcome a second volume of Mr. Verrall's great work, and to learn that two more are in active preparation.

The present volume opens with a general account of the Diptera Orthorrhapha, including an admirable description of the metamorphoses of the Diptera Brachycera and of the *Platypezidae, Pipunculidae*, and *Syrphidae*, by Dr. Sharp.

The purely systematic part deals with the *Stratiomyidae, Acanthomeridae, Leptidae, Tabanidae, Nemestrinidae, Cyrtidae, Bombylidae, Therevidae, Scenopinidae, Mydaidae, Apioceridae,* and *Asilidae.*

The reputed British species of the different families are next treated of, and the volume concludes with a systematic list of the families of Palaearctic Diptera Brachycera included in the present volume.

The figures of Mr. J. E. Collin are wonderfully clear, and merit all praise.

Dipterologists throughout the world are under a deep obligation to the author for what promises to be a remarkable and invaluable work.

W. E. C.

CURRENT LITERATURE.

I.—General Subject.

Forbes, S. A.—Aspects of Progress in Economic Entomology. Journ. Econ. Entom., 1909, vol. ii, pp. 25-35.

Froggatt, W. W.—Notes on the Value of Introduced Parasites or Beneficial Insects. W.I. Bulletin, 1908, vol. ix, pp. 262-264.

Hopkins, A. D.—Work of the Bureau of Entomology against Forest Insects. Journ. Econ. Entom., 1908, vol. i, pp. 343-348.

Pierce, W. D.—A List of Parasites known to attack American Rhynchophora. Journ. Econ. Entom., 1908, vol. i, pp. 380-396.

II.—Anatomy, Physiology, and Development.

Barber, C. A.—Studies in Root Parasitism. IV.—The Haustorium of *Cansjera rheedii*. Mem. Dept. Agric. India, Bot. Ser., 1908, vol. ii, no. 5, pp. 1-37, plts. i-xi.

Guilbeau, B. H.—The Origin and Formation of the Froth in Spittle-Insects. Amer. Nat., 1908, vol. 42, pp. 783-798, 8 figs.

Pierce, F. N.—The Genitalia of the Group Noctuidae of the Lepidoptera of the British Islands. Pp. xii + 88, 32 plts. Liverpool: A. W. Duncan, 1909. Price 7s. 6d.

It is refreshing to find a lepidopterist in the British Isles who, for upwards of twenty years, has been interested in the wonders of the structure of these insects, rather than in collecting or the dry investigation of nomenclature. If for no other reason we extend a hearty welcome to a book that at once commands attention by reason of its detail and patient and minute accuracy.

The author enumerates upwards of three hundred species contained in one hundred and seven genera.

The descriptions throughout are clear, though brief, and the drawings are excellent. Like most lepidopterists, Mr. Pierce is content to quote the names of species without the genera, which is to be regretted, as also the absence of plate references, and authorities for the different genera and species.

W. E. C.

III.—General and Systematic Biology, and Geographical Distribution.

Bagnall, R. S.—On some New Genera and Species of Thysanoptera Trans. N.H. Soc. Northumberland, 1908, vol. iii, pp. 183-217 plts. vi-vii.

Bagnall, R. S.—*Cryptothrips dentipes;* A Genus and Species of Thysanoptera new to the British Isles. Irish Nat., 1908, vol. xviii, pp. 41.

Berlese, Antonio.—Elenco di generi e specie nuove di Acari. Redia, 1908, vol. vi, pp. 1-15.

Berlese, Antonio.—Nuovi Acerentomidi. Redia, 1908, vol. v, pp. 16-19. T. i.

The following new species are described *Acerentomon confine, minimum, cephalotes; Eosentomon transitorium,* gen. and sp. nov.

Berlese, Antonio.—Osservazioni intorno agli Acerentomidi. Redia, 1908, vol. v, pp. 110-122.

The author gives a general account of the *Protura,* and describes the following as new: *Acerentomon maius,* n.sp., *Acerentulus tiarneus* and *gracilis,* gen. and sp. nov.

Buffa, P.—Contribuzione alla conoscenza dei Tisanotteri italiani. Redia. 1908, vol. v, pp. 133-137.

Buffa, P.—Tisanotteri nuovi. Redia, 1908, vol. v, pp. 123-125, 2 figs.

Busck, A.—A Generic revision of American moths of the Family *Oecophoridae,* with descriptions of new species. Proc. U.S. Nat. Mus., 1908, vol. xxxv, pp. 187-207.

Dyar, H. G., and Knab, F.—Descriptions of some new Mosquitoes from Tropical America. Proc. U.S. Nat. Mus., 1908, vol. xxxv, pp. 53-70.

Del Guercio, G.— Sull 'apparizione di una particolare form a larvale nelle *Phylloxera acanthochermes,* Kol. Redia, 1908, vol. v, pp. 92-97, 6 figs.

Del Guercio, G.—Ancora sulle forme autunnali della *Phylloxera acanthochermes,* Kol. Redia, 1908, vol. v, pp. 138-143, 8 figs.

Del Guercio, G.—Le vicende della fillossera del leccio nei terreni aridi e in quelli irrigui. Redia, 1908, vol. v, pp. 144-155, T. vii.

d'Emmerez de Charmoy.—On Three new species of *Culex* collected during the anti-malarial campaign in Mauritius in 1908. Ann. Trop. Med. and Paras., 1908, vol. ii, pp. 257-264, plt. x.

De Stefani Perez, T.—I primi Zoocecidii della Somalia italiana. Marcellia, 1908, vol. vii, pp. 142-149.

Franklin, H. J.—Description of Larvae and Pupae of certain species of *Papaipema*. 12th Rpt. State Entom., Minnesota, 1908, pp. 197-200, figs. 102, 103.

Gillette, C. P.—Notes and Descriptions of some Orchard Plant Lice of the Family *Aphididae*. Journ. Econ. Entom., 1908, vol. i, pp. 359-369, plt. 8, and 7 text figs.

Hodgkiss, H. E.—Notes on the Grass Mite, *Pediculopsis graminum*, Reuter. Journ. Econ. Entom., 1908, vol. i, pp. 375-377.

Kearfott, W. D.—Descriptions of new species of North American Crambid Moths. Proc. U.S. Nat. Mus., 1908, vol. xxxv, pp. 367-393.

Kieffer, J. J.—Description de quelques Galles et d'Insectes gallicoles de Colombie. Marcellia, 1908, vol. vii, pp. 140-142, 1 fig.

Kieffer, J. J.—Description de Galles et d'Insectes gallicoles d'Asia. Ibid, pp. 149-167, Tav. iii, iv, 4 figs.

Mariani, G.—Nuovo contributo alla Cecidologia italica. Marcellia, 1908, vol. iv, pp. 110-115.

Neumann, L. G.—A new Indian Tick, *Ornithodorus lahoriensis*. Journ. Trop. Vetr. Sci., 1908, vol. iii, pp. 462-467, plt. xxii and 1 fig.

Paoli, Guido.—Intorno a galle causate della puntura del *Dacus oleae* (Rossi), Meigen, sull'Oliva. Redia, 1908, vol. v, pp. 27-30, 1 fig.

Paoli, Guido.—Monografia del genere *Dameosoma*, Berl., e generi affini Redia, 1908, vol. v, pp. 31-91, T. iii-v, and 4 figs.

Rehn, J. A. G.—Two new species of Neotropical Orthoptera of the Family *Acrididae*. Proc. U.S. Nat. Mus., 1908, vol. xxxv, pp. 395-398.

Ribaga, C.—Un nuova Copeognato dell' Isola di Giava. Redia, 1908, vol. v, pp. 20-26, T. ii.

Ribaga, C.—Copeognati estraeuropei del Museo civico di storia naturale di Genova. Redia, 1908, vol. v, pp. 98-109, T. vi.

Robertson, M.—A Preliminary Note on Haematozoa from some Ceylon Reptiles. Spolia Zeylanica, 1908, vol. v, pp. 178-185, 13 figs.

Salem, V.—Nuove galle dell' Erbario del R. Orto botanico di Palermo. Marcellia, 1908, vol. iv, pp. 105-109.

Smith, John B.—A Revision of some species of *Noctuidae* heretofore referred to the Genus *Homoptera*, Boisduval. Proc. U.S. Nat. Mus., 1908, vol. xxxv, pp. 209-275, plts. xxxi-xxxvi.

Stebbing, E. P.—On some Undescribed *Scolytidae* of Economic Importance from the Indian Region. I. Indian For. Mem., 1908, vol. i, pt. i, pp. 1-12.

Trotter, A.—Due precursori nell'applicazione degli Insetti carnivori a difesa delle piante coltivate. Redia, 1908, vol. v, pp. 126-132.

Trotter, A.—Nuovi Zoocecidii della flora italiana. Marcellia, 1908, vol. iv, pp. 116-120.

Trotter, A.—Rapporti fungionali tra le galle di *Dryophanta folii* ed il loro supporto. Marcellia, 1908, vol. vii, pp. 167-174.

Tucker, E. S.—Wasp storing Katykids in a well. Journ. Econ. Entom., 1908, vol. i, pp. 340, 341.

Washburn, F. L.—Notes on *Empoasca mali,* Le B. Journ. Econ. Entom., 1909, vol. 2, pp. 54-59, plt. 2.

Wheeler, W. M.—A European Ant (*Myrmica levinodis*) introduced into Massachusetts. Journ. Econ. Entom., 1908, vol. i, pp. 337-339.

IV.—Agriculture and Horticulture.

Bailey, V.—Harmful and Beneficial Mammals of the Arid Interior, with Special Reference to the Carson and Humbolot Valleys, Nevada. U.S. Dept. Agric., Biol. Sur., Farmer's Bull. 335, 1908, pp. 1-31, 9 figs.

Ballou, H. A.—Treatment of Cotton Pests in the West Indies in 1907. W.I. Bulletin, 1908, vol. ix, pp. 235-242, 10 figs.

Cathcart, C. S.—Analysis of Paris Green and Lead Arsenate. New Jersey Agric. Exp. Stat., Bull. 214, 1908, pp. 3-14.

Charvot, J.—Note sur la destruction du *Phylloxera*. Comptus Rend., 1908, pp. 3-14.

Collinge, Walter E.—The Apple Blossom Weevil. Journ. Board Agric., 1908, vol. xv, pp. 674-678.

Darlington, H R.—Yellow Stripe in Daffodils. Journ. Roy. Hort. Soc., 1908, vol. xxxiv, pp. 161-166.

Doane, R. W.—Notes on *Aspidiotus destructor* (Sig.), and its Chalcid parasite in Tahiti. Journ. Econ. Entom., 1908, vol. i, pp. 341, 342.

Duchesne, M. C.—Beech Coccus, an Increasing and Serious Pest. Journ. Land Agents' Society, 1908, vol. vii, pp. 578-583, 3 figs.

Evans, I. B. P.—The Mildews of the Grape Vine. Transv. Agric. Journ., 1909, vol. vii, pp. 213-217, 2 plts.

Evans, I. B. P.—A Note on the European Apple-tree Canker Fungus. Ibid., p. 217, plt. 32.

French, Jr. C.—A new Vegetable Pest. The Tomato Weevil. Vict. Journ. Dept. Agric., 1908, vol. vi, pp. 754, 755.
Desiantha novica, Lea.

Gossard, H. A.—Spraying for Codling Worm. Ohio Agric. Exp. Stat., Bull. 191, 1908, pp. 103-125, 24 figs.

Gossard, H. A.—The Catalpa Midge, *Cecidomyia catalpae*, Comstock. Ohio Agric. Exp. Stat., Bull. 197, 1908, pp. 1-13, 9 figs.

Güssow, H. T.—Parasitic Rose Canker. Journ. Roy. Hort. Soc., 1908, vol. xxxiv, pp. 222-230, 4 figs.

Hewitt, C. G.—The Large Larch Sawfly. Journ. Board Agric., 1908, vol. xv, pp. 649-660, 4 figs.

Houser, J. S.—The More Important Insects affecting Ohio Shade Trees. Ohio Agric. Exp. Stat., Bull. 194, 1908, pp. 169-243, 47 figs.

Howard, L. O.—Report of the Entomologist for 1908. Ann. Rpt. Dept. Agric. U.S.A., 1908, pp. 5-47.

Hunter, W. D.—What can be done in Destroying the Cotton Boll Weevil during the Winter. U.S. Dept. Agric., Circ. No. 107, 1909, pp. 1-4.

Jones, P. R.—The Grape-leaf Skeletonizer (*Harrisana americana*, G.-M.). U.S. Dept. Agric., Bur. of Entom., Bull. No. 68, pt. viii, 1909, pp. 77-90, figs. 12-17.

Juritz, C. F.—Sulphur as a Pest Remedy. Agric. Journ. C. of G.H., 1908, vol. xxxiii, pp. 719-730, 5 figs.

Lea, A. M.—Insect and Fungus Pests of the Orchard and Farm. Pp. 1-176, 63 text figs. Tasmania: John Vail, 1908.

Lounsbury, Chas. P.—Pears and Pear Blight. Agric. Journ. C. of G.H., 1908, vol. xxxiii, pp. 547-580.

Mally, C. W.—Maize Stalk Borer (*Sesamia fusca*). Agric. Journ. C. of G.H., 1908, vol. xxxiii, pp. 616-624, 2 figs.

Mally, C. W.—Cutworms. Poisoned Bait Remedy. Agric Journ. C. of G.H., 1908, vol. xxxiii, pp. 628-635, 3 figs.

Morrill, A. W.—Fumigation for the Citrus White Fly as adapted to Florida conditions. U.S. Dept. Agric., Bur. of Entom. Bull. No. 76, 1908, pp. 1-73, plts. i-vii, and 11 figs.

If one were to suggest to the majority of British fruit growers the advisability of fumigating the trees in their comparatively tiny orchards as compared with those of which Dr. Morrill writes, what derision one would call forth.

After a careful perusal of this bulletin we are more than ever convinced that the British fruit grower has yet very largely to learn how to treat his orchard.

When one realizes that the American fruit grower is willing to spray three and four times at a cost of 1s. 2d. per tree, or fumigate at the same outlay, it is not to wondered at that his fruit is so much better than ours, where cheapness and inefficiency seem to be the chief considerations.

Dr. Morrill's work will well repay careful study, and will come as a revelation to many growers who fancy they have nothing further to learn respecting orchard and plant pests and their treatment, but whose orchards and crops would disgrace an amateur.

Potter, M. C.—On a method of checking Parasitic Diseases in Plants. Journ. Agric. Sci., 1908, vol. iii, pp. 102-107.

Quayle, H. J.—The Grape Leaf-hopper (*Typhlocyba comes*, Say). Agric. Exp. Stat. Berkeley, Cal., Bull. No. 198, 1908, pp. 177-218, 23 figs.

Russell, H. M.—Experiments for the Control of the Red Spider in Florida (*Tetranychus bimaculatus*, Harv.). Journ. Econ. Entom., 1908, vol. i, pp. 377-380.

Sanderson, E. Dwight.—The Apple-Leaf Aphis. New Hampshire Agric. Exp. Stat., Circ. No. 3, 1908, pp. 1-6, 4 figs.

Sanderson, E. Dwight.—The Oyster-shell Scale. Ibid., Circ. No. 4, 1908, pp. 1-4, 3 figs.

Sanderson, E. Dwight.—The San Jose Scale. Ibid., Circ. No. 5, 1908, pp. 1-12, plt. i, 5 figs.

Slingerland, M. V.—Must the Calyx cup be filled? Journ. Econ. Entom., 1908, vol. i, pp. 352-354, plt. 7.

Smith, J. B.—Insecticide materials and their application: with suggestions for practice. New Jersey Agric. Exp. Stat., Bull. 213, 1908, pp. 3-46.

Smith, R. E., and Butler, O.—Gum Disease of Citrus Trees in California. Univ. Calif. Agric. Exp. Stat., Bull. No. 200, 1908, pp. 235-270, 14 figs.

Stebbing, E. P.—A Further Note on the Chilgoza Bark-boring Beetles of Zhob. Indian For. Rec., 1908, vol. i, pt. iii, pp. 245-251.

Taylor, E. P.—Dimples in Apples from oviposition of *Lygus pratensis*, L. Journ. Econ. Entom., 1908, vol. i, pp. 370-375, plts. 10, 11.

Washburn, F. L.—Twelfth Report of the State Entomologist of Minnesota for the years 1907 and 1908. Pp. x + 11205, 1 plt. and 103 figs. St. Anthony Park: 1908.

Mr. Washburn's Reports are always interesting and full of valuable information, and the well-illustrated one before us fully maintains the high standard set by previous ones.

Amongst the various subjects discussed we would mention articles on the Apple Leaf Hopper, Grasshoppers, Lice [Hemiptera] affecting Grain, Crown Gall in Raspberries, Spraying Experiments, some destructive Shade Tree Pests, Work with the Cabbage Maggot, Strawberry Root Louse (*Aphis forbesi,* Weed), White Grubs in Lawns, Stalk Borers, Two Enemies of Bee Keepers, and Three new Hymenopterous Paarsites of the Cabbage Maggot, in addition to shorter notices of many other insects.

W. E. C.

Woglum, R. S., and Wood, W.—Cyanide as an Insecticide. Journ. Econ. Entom., 1908, vol. i, pp. 348-350.

V.—Forestry.

Hopkins, A. D.—An Example of Forest Insect control at a profit. Journ. Econ. Entom., 1909, vol. 2, pp. 49-53.

VI.—Fisheries.

[Anon.].—Causes of Mortality in Trout. The Field, 1908, p. 221.

VII.—Medicine.

Christophers, S. R.—Insect Flagellates. Indian Med. Gaz., 1908, pp. 433-435.

Christophers, S. R.—Mammalian Leucocytozoa. Indian Med. Gaz., 1908, pp. 435, 436.

Felt, E. P.—The Economic Status of the House-fly. Journ. Econ. Entom., 1909, vol. 2, pp. 39-46.

Nash, J. T. C.—Flies as a Nuisance, and Flies as a "Dangerous Nuisance." Lancet, 1908, pp. 131, 132.

VIII.—Animal Diseases.

Christy, J. M.—Lung-sickness or Contagious Pleuro-pneumonia of Cattle. Transv. Agric. Journ., 1909, vol. vii, pp. 199-201.

Cotton, E. C.—Tick Eradication. The Life-history and Habits of the North American Fever Tick, with special reference to eradication Univ. Tennessee Agric. Exp. Stat., Bull. No. 81, 1908, pp. 53-71, 5 figs.

Dodd, S.—Tick Fever, or Redwater. Queensland Agric. Journ., 1908, vol. xxi, pp. 245-251.

Duerden, J. E.—Experiments with Ostriches.—VIII. Agric. Journ. C. of G.H., 1908, vol. xxxiii, pp. 786-791, 2 figs.

Herrick, G. W.—Notes on the Hen Flea (*Xestopsylla gallinacea*). Journ. Econ. Entom., 1908, vol. i, pp. 355-358.

Malden, W.—Further Report on a Disease of Bees in the Isle of Wight. Journ. Board Agric., 1909, vol. xv, pp. 809-825.

Pease, H. T.—Spirochaetosis in Fowls due to the Fowl Tick. Agric. Journ. India, 1908, vol. iii, pp. 309-322, plt. xl, 4 figs.

Phillips, E. F.—A Brief Survey of Hawaiian Bee Keeping. U.S. Dept. Agric., Bur. of Entom., Bull. No. 75, pt. v, pp. 43-58, plts. v-x.

Robertson, W.—Notes on Ostrich Parasites. Agric. Journ. C. of G.H., 1908, vol. xxxiii, pp. 583-588, 6 figs.

Ward, A. R., and Haring, C. M. The Tuberculosis Problem. Univ. Calif. Agric. Exp. Stat., Bull. No. 199, 1908, pp. 221-234, 2 figs.

White, G. F.—The Relation of the Etiology (Cause) of Bee Diseases to the Treatment. U.S. Dept. Agric., Bur. of Entom., Bull. No. 75, pt. iv, 1908, pp. 33-42.

Wooldridge, G. H.—Tuberculosis in Cattle. Journ. Land Agents' Society, 1908, vol. vii, pp. 571-577.

THE

JOURNAL OF ECONOMIC BIOLOGY.

A CONTRIBUTION TO OUR KNOWLEDGE OF THE BRITISH THYSANOPTERA *(TEREBRANTIA)*, WITH NOTES ON INJURIOUS SPECIES.

By

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ALTHOUGH the insects of the Order Thysanoptera, or, at any rate, those belonging to the sub-order *Terebrantia*, are admittedly species of economic importance, it is only comparatively recently that they have received any marked attention by entomologists, and since the publication of Haliday's important papers on the British species in 1836 and 1852, the Thysanoptera have been systematically neglected by British naturalists, probably on account of the minute size and somewhat difficult characters of differentiation of the majority of species, coupled with the fact that they must be collected in spirit, to which mode of collecting so many of our entomologists seem to have a very distinct aversion.

In January, 1908, I published some notes on certain British species, recording as new to our fauna *Megathrips lativentris* (Heeger); *Trichothrips caespitis,* Uzel; *Euthrips robustus* (Uzel); *Oxythrips ajugae,* Uzel; *O. parviceps,* Uzel; *Uzeliella lubbocki,* Bagnall; *Heliothrips femoralis,* Reuter; *Parthenothrips dracaenae* (Heeger); *Thrips communis,* Uzel; and *T. major,* Uzel; and in three short papers published this year, *Anaphothrips orchidaceus,* Bagnall; *Megathrips nobilis,* Bagnall; *Cryptothrips dentipes* (Reuter); *Trichothrips copiosus,* Uzel; and *T. semicaecus,* Uzel, are recorded as British. It should be noted, however, that *Thrips communis,* Uzel, is a synonym of *T. tabaci,* Lindeman, described in 1888,[1] and is the species recorded as the "Thrips on onion plants," by Mr. Shipley, F.R.S., in 1887[2]. In the present preliminary paper

[1] Die Schadlichsten Insekten des Tabak in Bessarabien, 1888, p. 15, 61-75.

[2] Bulletin 10, Miscellaneous Information Royal Gardens, 1887, p. 18.

further records are given for *Parthenothrips dracaenae, Heliothrips femoralis, Anaphothrips orchidaceus* and *Thrips tabaci,* whilst *Chirothrips similis,* sp. nov., *Euthrips orchidii,* Moulton, *E. longipennis,* Bagnall, *E. inconsequens* (Uzel), *E. pyri,* Daniel, *Leucothrips nigripennis*, Reuter, *Heliothrips haemorrhoidalis* var *abdominalis,* Reuter, *Thrips salicaria,* Uzel, and *T. juniperina* (L.), are for the first time recorded from the British Isles, the male of *E. pyri* being new to science. Some of these additions are of considerable interest, most notably the records of *E. pyri* and *T. juniperina.* The former was previously only known from California, U.S.A., and is regarded as one of the most injurious insects, whilst the species I refer to *Thrips juniperina,* Linnaeus, though recognised between the years 1744 and 1806, has since been lost to science. Most of these species will be fully described and figured in a future paper, which I hope to prepare on the British Thysanoptera, and, so that this essay on the British species may be more complete, I shall be very pleased to receive and acknowledge the communication of collections from all parts of the British Isles, and to give hints as to the best methods of collecting, etc., to those who wish to take up their collection and study.

I would take this opportunity of thanking Mr. Collinge for the material he has so kindly submitted to me.

Order THYSANOPTERA.

Sub-Order TEREBRANTIA.

Family **Thripidae.**

Chirothrips similis, sp. nov.

This species very closely resembles the common *C. manicatus,* and differs chiefly by its much larger size, the broader basal antennal joint, the longer and more linear abdomen, and the arrangement of spines on the fore-wing. It is a large species, my examples measuring 1.5-1.6 mm. in length.

Two females swept from grass, Gibside, August, 1908. I know the exact spot where these specimens were captured and hope to take both sexes this summer, and to describe and figure the species in detail in my proposed essay on the British Thysanoptera.

The following table of the known species of the genus *Chirothrips* may be useful :—

1. Antennae with the second joint simple—
hamatus, Trybom (*dudae,* Uzel).

II. Antennae, with the second joint ending in a blunt prominence at the outer angle.

1. Without spines at each hind-angle of prothorax—
obesus, Hinds, *crassus,* Hinds.

2. With spines at each hind-angle of prothorax :—

i. Female. Size smaller (0.8-1.1 mm.); abdomen ovate, not twice as long as broad; hind-vein of fore-wing with four spines, two near fork and two towards tip—
manicatus, Haliday.

ii. Female. Size larger (1.5-1.6 mm.) ; abdomen elongate-ovate, three times as long as broad; hind-vein of fore-wing with six more or less regularly placed spines—
similis, sp. nov.

Limothrips cerealium, Hal.
(**L. avenae,** Hinds.).

I have taken two examples of the female from the flower of the bittersweet (*Solanum dulcamara*) Swalwell, July, 1907, and two females from the sap of a felled pine tree at Winlaton on the 14th of September, 1907, but have never found the species in numbers excepting on cereal crops. It is therefore very interesting to note that Mr. Collinge has found the female of *L. cerealium* in numbers in witches broom, on birch, 1907, at Solihull, Warwickshire, though neither the earlier stages or the male were taken.

Limothrips denticornis, Hal.

Three European species of thrips are known to infest cereal crops to a serious extent, namely *Limothrips cerealium,* Hal., *Stenothrips, graminum,* Uzel, and *Anthothrips aculeatus* (Fab.), and are, as a rule, found in large numbers. *Stenothrips* is recorded from Bohemia and Italy, but has not yet occurred in the British Isles.

Limothrips denticornis has not been regarded as a destructive insect, in fact it is a scarce species, and is usually found singly on various flowers and leaves. In looking over some material collected from cereals at Haydon Bridge, August, 1907, I was surprised to find that *L. cerealium* was not represented at all, its place being taken by *L. denticornis,* which was extremely abundant in all stages,

and it is interesting to note that the male, which is much smaller than the female and without wings, was more numerously represented than the female.

Euthrips orchidii, Moulton, 1907.

Euthrips orchidii, Moulton : U.S. Dept. of Agriculture, Bureau of Entomology, Tech. Ser., No. 12, pt. III, 1907, p. 52, pl. ii, figs. 15-18; Bagnall : Ann. de la Soc. Entomologique de Belgique, 1909, liii, p. 172.

This pretty little species occurs sparingly on various species of *Adiantum* in a propagating house, and on *Iresine, Begonia,* and other plants in the Palm House, Leazes Park, Newcastle-on-Tyne, December, 1908.

Distribution.—California, U.S.A., four specimens from orchids (Bremner); Brussels, Belgium, sparingly on *Chamaeodorea fragrans* and commonly on *Ficaria* (R.S.B.); England.

Euthrips longipennis, Bagnall, 1909.

Euthrips longipennis, Bagnall : Ann. de la Soc. Entomologique de Belgique, 1909, liii, p. 173.

Another minute hot-house species which will probably be found to be widely distributed. Not uncommon on *Adiantum* and on various plants in the Palm House, Leazes Park, Newcastle-on-Tyne, December, 1908.

Distribution.—Brussels Botanical Gardens, Belgium, on species of *Chamaeodorea,* chiefly *C. fragrans* (R.S.B.); England.

Euthrips inconsequens (Uzel), 1895.

Physopus inconsequens, Uzel : Mon. der Ordnung Thysanoptera, 1895, p. 117; Buffa : Atti della Soc. Tosc. di Sci. Nat., Memorie, xxiii, 1907, p. 61.

Several examples of the female in the young buds of a sycamore tree, Gibside, Co. Durham, May, 1907. I have had the advantage of comparing my specimens with co-types sent me by Professor Uzel.

Distribution.—Bohemia (Uzel); Italy (Buffa); England.

Euthrips pyri, Daniel, 1904.

Pear Thrips.

Euthrips pyri, Daniel : Ent. News, xv, No. 9, 1904, pp. 293-297; Moulton : U.S. Dept. of Agriculture, Bureau of Entomology, Tech. Ser., No. 12, pt. III, p. 53, pl. III, figs. 19-24, and *l. c.*, Bulletin No. 68, pt. I, 1907, pp. 1-16.

Mr. Walter E. Collinge, Director of the Cooper Research Laboratory, Berkhamsted, has sent me numerous examples of this very injurious species taken in Plum blossom, Evesham. *E. pyri* is a fruit tree pest which attacks nearly all varieties of deciduous fruits and has been responsible for more damage than any other known species of thrips, though, until now, only known from the San Francisco Bay counties and the Sierra Nevada foothills, California, U.S.A. During the season of 1905 large orchard sections, sometimes miles in length, suffered an almost complete failure of crops chiefly through the devastations of this small insect, and although Mr. Dudley Moulton and his assistants have studied the life-history, etc., of *E. pyri* very closely during the past four years, no really efficient check has been devised. What is evidently a true entomogenus fungus-parasite, *Cladosporium* sp., has been found to attack the different stages of the Pear thrips, and under certain conditions to help considerably in checking that pest, but its effectiveness can only be uncertain owing to the development of the fungus being to a very large extent subject to certain climatic conditions.

Those interested in the growth of deciduous fruits should refer to Mr. Dudley Moulton's very interesting and able memoir on the Pear Thrips referred to above. It is difficult to say to what extent this pest is distributed in Britain and all fruit-growers should make a point of examining the blossom of the different trees, and if thrips are present examples should be collected into tubes of about 70 per cent. alcohol and sent, with full data, to Mr. Collinge, or to the present writer, to be reported upon.

Male.—An example of the male is amongst the specimens submitted to me by Mr. Collinge; it is much smaller than the female and the wings considerably over-reach the tip of abdomen. Though countless specimens have been examined from the orchards of California, the male was never discovered, and this sex is therefore new to science.

Distribution.—California, U.S.A. (Miss Daniel, etc.); England.

Anaphothrips orchidaceus, Bagnall, 1909.

Orchid Thrips.

Anaphothrips orchidaceus, Bagnall: Ent. Mon. Mag., 1909, Sec. Ser., xx, p. 33; Ann. de la Soc. Entomologique de Belgique, 1909, liii, p. 171.

Since describing the Orchid Thrips from London, Northumberland, and Dublin, I have taken it at Glasgow (December, 1908) on *Cypripedium,* and have myself collected the perfect insect and larvae in the Kew Gardens, London, from *Epidendron* and *Cymbidium,* February 2nd, 1909.

It is a difficult pest to eradicate either by spraying or fumigation; immediately it is disturbed it seeks safety by rapidly running into the innermost recesses at the base of the leaves. It is now known from *Odontoglossum, Zygopetalum, Cypripedium, Cymbidium* and *Epidendron.*

Distribution.—England and Ireland (R.S.B.); Brussels, Belgium (R.S.B.); Scotland.

Leucothrips nigripennis, Reuter, 1904.

Fern Thrips.

Leucothrips nigripennis, Reuter: Meddel. af Soc. pro Fauna et Flora Fennica, 1904, xxx, pp. 106-109; Bagnall: Ann. de la Soc. Entomologique de Belgique, 1909, liii, p. 172.

A single specimen on a species of fern allied to *Pteris,* Glasgow, December, 1908, and numerous examples on *Adiantum,* and on various plants in the Palm House, Leazes Park, Newcastle-on-Tyne, during the same month.

Distribution.—Helsingsfors, Finland, on species of *Pteris* (Reuter); Brussels, Belgium, on *Davallia maguscula,* (R.S.B.); England and Scotland.

Heliothrips haemorrhoidalis (Bouché).

var. *abdominalis,* Reuter, 1892.

In hot-house with type, not uncommon, London, Cambridge, and Newcastle.

Heliothrips femoralis (Reuter).

Not uncommon in hot-house on a large variety of plants. Kew Gardens and Newcastle.

Parthenothrips dracaenae (Heeger).

A few specimens from Palm House, Leazes Park, Newcastle-on-Tyne, December, 1908. Have also received specimens from Kew Gardens, London, collected by the late George Nicholson.

Aptinothrips nitidulus, Hal.

Described in 1836 on specimens sent by F. Walker from England, and recently recorded by me from the Island of Arran, Scotland. In July, 1908, I found the species on *Aster tripolium,* near Arrochar, at the head of Loch Long, Scotland; and in September of the same year I again met with it at Portmarnock, near Dublin, on *Aster tripolium, Glaux maritima,* and *Juncus maritima.* Considering that the Portmarnock saltmarsh and sandhills were one of Haliday's classical hunting grounds it is strange that he did not take this species there.

Thrips salicaria, Uzel, 1895.

Thrips salicaria, Uzel: Mon. der Ordnung Thysanoptera, 1895, p. 162; Trybom: Entomologisk Tidskrift, 1896, xvii, p. 92; Reuter: Meddel. af Soc. pro Fauna et Flora Fennica, xvii, No. 2, 1899, p. 58.

Very local; several specimens on leaves of an old willow tree (*Salix* sp.), on the banks of the river Derwent, near Winlaton Mill, County Durham.

Distribution.—Bohemia (Uzel); Sweden (Trybom), and Finland (Reuter); England.

Thrips juniperina (Linn.), 1761.

Length, 1.0-1.2 mm.; breadth of mesothorax, 0.2 mm. General colour fuscous to greyish brown, legs (excepting coxae) and third antennal joint decidedly lighter, fore-edge of femora and tibiae slightly darker. Head not quite so long as wide, and slightly longer than the prothorax; cheeks widened behind eyes and from thence practically parallel, roughened; forehead evenly rounded between eyes, which are moderately prominent, occupying laterally one-

third the length of the head, the space between them being about the width of the two eyes together; black, coarsely faceted, and pilose. Ocelli sub-approximate, yellow with orange-red crescentic margins inwardly. Mouth-cone pointed, blackish at tip; maxillary palpi three-jointed, the second joint being the shortest, and the basal and apical joints sub-equal in length; tipped with three sensory filaments; labial palpi, with second joint very slender and much longer than the basal joint, which is very short. Antennae much longer than head, inserted beneath vertex and approximate at base; sixth segment the longest, about four times the length of the single-jointed style; third segment only slightly less than the sixth, longer than either the fourth or fifth.

Prothorax wider than head, and about twice as wide as long, transverse, sides parallel; two conspicuous bristles at each hind-angle, which are comparatively short, being about one-third the length of prothorax. Mesothorax longer than the prothorax and much wider, roundly widened from the fore-angles; metathorax shorter and abruptly narrower than the mesothorax, sides slightly accurate. Hind tibia armed with a strong spine at tip within. Wings fully developed, silvery white; veins weak; fore-wing with fore-margin and the hind-vein set regularly with conspicuous dark brown spines, fore-margin with about twenty-two, and 8-10 on hind vein; fore-vein with a series of three and three on basal half, and three scattered over distal half. Abdomen elongate-ovate, as wide as mesothorax, and a little more than twice as long as wide. Posterier edge of ninth segment encircled with eight long spines, and the tip of tenth segment with six similar, though shorter, spines.

Comes nearest *Thrips tabaci*, Lindeman, differing chiefly in the darker colour of the body, the broader prothorax, which is strongly transverse, the evenly-rounded frons, and in the colour of the wings and the number and arrangement of the spines on the fore-wing.

Whilst staying with my friend, Prof. Hudson Beare, at Nethy Bridge, Inverness-shire, July, 1908, I obtained a good deal of Thrips material from the Juniper bushes which abound in the forest near Nethy Bridge, and also from Juniper on the slopes of the Cairngorm Mountain. With the exception of a few stray examples of *Euthrips ericae* (Hal.), and of a very minute species of *Thrips* not yet identified, all were referable to a species of *Thrips*, s.s., which, owing to its food-plant, I can only presume to be the *Thrips juniperina* of Linnaeus. On p. 274 of his Monograph, Professor Uzel gives the synonym of *T. juniperina*. It was first recognised by De Geer in 1744 and described in the four words *Physapus*

fuscus, alis albicantibus,[1] and two years later Linnaeus described it as *Thrips elytris niveis, corpore fusco*,[2] but it was only in the year 1761 that he gave to it the name of *T. juniperina*. From 1761 to 1806 this species is mentioned in the works of De Geer, Goeze, Schrank, Fabricius, Gmelin, Berkenhout, de Villers, Stew, and Turton, and since then *T. juniperina* has been lost to science, sunk in oblivion only to be recognized again after the lapse of more than a hundred years! It should be here mentioned that in the year 1789 Berkenhout included *Thrips juniperina* in his "Synopsis of the Natural History of Great Britain and Ireland," whilst in 1836 Haliday specially states that he had "in vain searched on the Juniper and flax for *Thrips juniperina* and *Thr. variegata*."[3] More recently, 1899, Prof. Reuter suggests with doubt that a species of *Aeolothripidae,* which he then described from *Abies* and *Convallaria,* namely *Rhipidothrips niveipennis*, Reut., was probably synonymous with *T. juniperina*.[4]

Thrips tabaci, Lindeman, (**communis,** Uzel).

One of the most injurious species of thrips. I have already recorded *T. tabaci* (under the name *communis*) as common on *Solanum dulcamara* and *S. tuberosa* in the North of England. It has apparently a very wide range of food-plants, and is often found in greenhouses. I have recently discovered it in large numbers and in all stages on *Iresine lindeni,* and other species of *Iresine* in propagating houses, Newcastle, London, and abroad, chiefly on plants infested by *Aphis*.

Platythrips tunicatus, Hal.

A rare species of which I have taken a single example of the female on *Vaccinium* at Corbridge-on-Tyne, July, 1908.

[1] K. Swenska Wetensk. Acad. Handl., V, p. 3, pl. 1, fig. 2.
[2] Fauna Suecica, Ed. I., p. 221.
[3] Ent. Mag., iii, p. 451.
[4] Acta Soc. pro Fauna et Flora Fennica, xvii, No. 2, p. 20.

A STEM BORING BEETLE ATTACKING COTTON IN THE SUDAN.

By

HAROLD H. KING,

Wellcome Research Laboratories, Khartoum.

With Plate V.

During April, 1907, the writer's attention was called to some cotton in the province of Berber, which was dying from some unknown cause. On investigation the lower portion of the stem was found to be attacked by the larva of one of the *Buprestidae*, but efforts made at the time to breed out the adult were unsuccessful. No further opportunity for studying the bionomics of this pest occurred until the summer of 1908, when the egg, pupa, and adult were obtained.

Specimens of the adult have been sent to Mr. C. O. Waterhouse, of the British Museum, who very kindly identified it as a member of the genus *Sphenoptera*, probably *S. neglecta*, Klug. The larva of a member of the same genus—*S. gossypii*—is recorded by Lefroy[1] to attack cotton in Bombay, Central Provinces and the Punjaub. Possibly the species here noted may prove to be identical with the Indian cotton stem borer.

Distribution in the Sudan.—The cotton stem borer has been recorded from the estate belonging to the Sudan Plantation Syndicate, Ltd., at Zeidah, Taragma, both in Berber Province and the Government Experimental Farm at Halfyia, Khartoum Province.

Host Plants.—This beetle has not been noticed by the writer to attack any other plant but cotton.

Description.—Egg (Figs. 1 and 5). Length, 1.25-1.50 mm. The embryo is enveloped in a thin, transparent to whitish membrane, which is covered by a dull, greenish blue, scale-like shell, in shape roughly oval, and bearing a number of irregular crinkles or ridges.

Larva (Fig. 2). Length up to 29 mm. Colour, head brown, mandibles black, thorax and abdomen yellowish white. The larva is of the typical Buprestid shape, the small head being retracted into the broad, flattened, first thoracic segment, and the abdomen being long and comparatively slender. The first thoracic segment bears both a dorsal and a ventral shield, the former being cut by a longitudinal median groove not quite extending to the anterior

[1] Bull. Imp. Institute, 1907, Vol. v, No. 2, pp. 164, 5.

border, and the latter by a Y-shaped, forwardly pointing groove, also barely reaching to the anterior border. The remainder of the body is flattened and wrinkled. The anus is situated at the apex of the terminal segment. The whole body bears a few scattered short pale hairs.

Pupa. (Fig. 3). Colour, yellowish white, eyes dull purple.

Adult. (Fig. 4). Length, 9-10.5 mm. Colour, greenish to reddish bronze.

When first it emerges from the pupal cell the beetle is covered with a fine yellowish meal, especially on the frons, sides of the pronotum, prosternum, metasternum, and venter generally. Head, pronotum, scutellum and venter, reddish bronze, irregularly punctured, and bearing a few scattered, short, pale hairs. Mesonotum and metanotum bright, metallic green, punctured. Metanotum bears a V-shaped backwardly pointing groove or gutter, in which is a median ridge, black. Dorsum of abdomen bright metallic green, punctured, and bearing a few scattered, short, pale hairs, with the exception of the basal margins of the segments, and a longitudinal median ridge, which are smooth, and have a bronzy tinge. Antenna of twelve segments—first, small, globular; second, elongated, swollen; third and fourth, smaller; remainder of antenna serrate. Elytrum reddish bronze, with punctures arranged in longitudinal rows, ridged towards the apex, and terminating in three short spines. Hind wing slightly clouded, especially towards the apex; costa terminates in a short spine; apical margin irregular. Tibiae with longitudinal rows of short, sharp spines; fore tibiae bear at the apices one longer spine, mid and hind tibiae two similar spines.

Habits and Life History.—The eggs are deposited singly, on the bark of the plant, on either the main stem or the branches—usually the former—and preferably in a crevice or wound. As many as nine eggs have been found on a stump of caravonica cotton, scarcely twelve inches high, but these had probably been laid by several beetles.

On hatching, the larva burrows into the stem, without rupturing the external shell of the egg, and commences a tortuous tunnel in the wood. Frequently this tunnel runs immediately under the bark for some distance, but it may go deeper into the wood, especially as the larva grows older, and may even, in the case of smaller branches, follow the course of the pith. It may also extend below the level of the ground. As the larva proceeds it packs the tunnel behind it with grass and wood chips, which, at first light in colour, become

dark brown in course of time. It invariably lies in its tunnel in a doubled-up position.

On attaining maturity the larva hollows out for itself a little chamber, usually near the bark, and pupates with its head end pointing towards the bark. The adult eventually gnaws a circular hole through the bark and makes its exit.

Duration of the Life Cycle.—This pest has not been followed by the writer throughout the whole of its life cycle, but the observations made indicate that there are two broods in the course of the year. The season for planting cotton is June and July, and the crop is picked by the end of March. The cotton wood is then usually collected and stocked, to be used later for fuel. The eggs of the first brood of borers can be found on young cotton in August and September, and the adults resulting from these emerge and oviposit in March. The larvae of this second brood probably complete their development in dead wood.

Damage Done by the Borers.—Plants infested by the borers are not usually killed outright, but live to the end of the season, though reduced in vitality. The borers are, however, frequently the indirect cause of the death of the plant, as white ants—termites—which will not, as a rule, attack healthy, living plants, readily attack those which have been weakened by the work of the beetle larvae.

Methods of Control.—The measures usually recommended for the control of the cotton boll-worms—*Earias insulana* and *Diparopsis castanea,* Hamp.—and the cotton stainer—*Oxycarenus hyalinipennis* —should be of benefit against the stem-borer. These measures are clean cultivation, the use of trap crops, and the burning as soon as is practicable of the cotton wood after the crop has been gathered.

EXPLANATION OF PLATE V.

Illustrating Mr. Harold H. King's paper on "A Stem Boring Beetle attacking Cotton in the Sudan."

Fig. 1.—Egg, much enlarged.

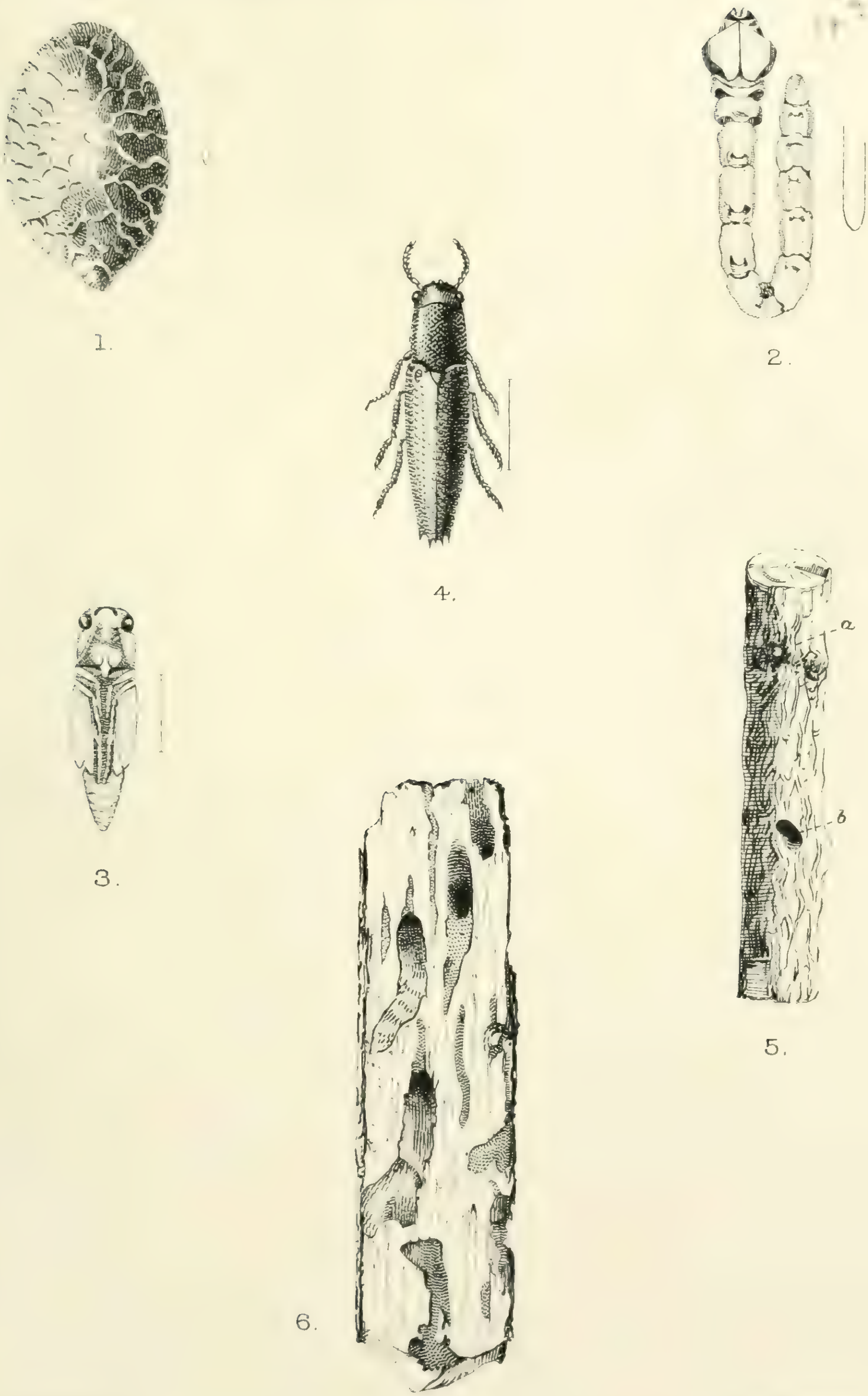
Fig. 2.—Larva, enlarged.

Fig. 3.—Pupa, ,,

Fig. 4.—Adult, ,,

Fig. 5.—Portion of stem of cotton plant, shewing egg *(a)* and exit hole of adult *(b)*.

Fig. 6.—Longitudinal section of stem of cotton plant shewing tunnels made by borers.



C. Beard del. Huth sc. et imp.

COTTON STEM BORING BEETLE.

DESCRIPTION OF A NEW GENUS OF COLLEMBOLA OF THE FAMILY *NEELIDAE*, FOLSOM.

By

WALTER E. COLLINGE, M.Sc., F.L.S., F.E.S.,

AND

JOHN W. SHOEBOTHAM, N.D.A.

With Plate VI.

The Genus *Neelus* was constituted by Folsom[1] in 1896 for a minute species of Collembola (*N. murinus*) found in a greenhouse in Cambridge, Mass., U.S.A., and which has since been found in Belgium by Willem,[2] and in Calabrien and Sicily by Börner.[3]

In 1901 Folsom[4] described a further species, *N. minutus,* from an old pine forest in Arlington, Mass., and this as yet has not been recorded from any other locality.

A closely allied genus, *Megalothorax,* was described by Willem[5] in 1900 for a small Collembolan obtained at the Botanic Gardens, Ghent, Belgium, and which has since been obtained from various European localities.

Börner[6] in 1903 added a second species, *M. incertus,* from Sicily.

Neither of these genera have until now been recorded for the British Isles.

Some few months ago one of us (J. W. S.) collected a number of minute Collembola in a greenhouse in the garden of the Rev. Canon A. M. Norman, F.R.S., Berkhamsted, and upon examination we find these to be closely allied to both of the above-mentioned genera, but differing in important structural characters.

Since collecting the above we have found a second member of the *Neelidae* in Berkhamsted (*Neelus murinus,* Folsom).

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[1] Psyche, 1896, vol. vii, pp. 391, 392, plt. 8.

[2] Ann. Ent. Soc. Belg., 1902, pp. 282, 283.

[3] Sitzber. Ges. Nat. Freund. Berlin, 1903, p. 160.

[4] Psyche, 1901, vol. ix, pp. 219-222, plt. 2.

[5] Ann. Soc. Ent. Belg., 1900, vol. 44, pp. 7-10, pl.

[6] *Op. cit.*, p. 160.

[Journ. Econ. Biol., 1909, vol. iv, No. 2.]

The Family *Neelidae* is of special interest in that the members exhibit a number of very generalised characters which, in part, form a link between the globular Sminthurid forms and the cylindrical Podurid ones, such for instance as the extension of the thorax and the greater mobility of the limbs, the short ventral tube and tuberculate papillae, the articulation and position of the head, and the form of the antennae.

The family *Neelidae* was constituted by Folsom in 1896,[1] but after the description of the genus *Megalothorax* by Willem in 1900,[2] he expressed the view that Willem's genus could not stand, being practically the same as *Neelus,* and further that this genus should be assigned to one family with *Sminthurus* and *Papirius*. With this view, however, few if any authors will agree, as the two above-mentioned genera are perfectly distinct, and undoubtedly find their proper places in a separate family that will precede the *Sminthuridae*.

We have not been able to examine examples of *Megalothorax,* but Börner's beautiful figures[3] are at once sufficient to show the close relationship of this genus to *Neelus,* and at the same time clearly indicate its distinctiveness from it and from that here described.

From a careful study of the description and figures of the known genera and species, together with the new genus (*Amerus*) and species here described, we believe there to be good grounds for regarding this latter genus as the most primitive, followed by *Megalothorax*, and then *Neelus*.

Family NEELIDAE, Folsom.

Psyche, 1896, vol. vii, p. 391.

= MEGALOTHORACIDAE, Börner.

Body globular in form, with the thoracic segments dominating. Segmentation somewhat indistinct. Almost naked. Abdomen situated ventrally; anal tubercle absent. Head horizontal, or vertical, broadly articulate. Antennae four-jointed, shorter than the head; last segment not ringed. Legs well separated. Ventral tube with tuberculate processes. Eyes absent. No post-antennal organ. No tenent hairs. Mid-gut divided into four spherical compartments. No tracheae.

The leading characters of the three known genera are set forth in tabular fashion for the purpose of comparison.

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[1] *Op. cit.*

[2] *Op. cit.*

[3] Wytsman's Genera Insectorum, 1906, pp. 1-5, 1 plt.

Amerus.	Megalothorax.	Neelus.
Head.—Vertical admitting of little movement being almost continuous with the body.	Vertical, but admitting of movement, being distinctly separated from the body.	Horizontal and movable being distinctly separated from the body.
Antennae.—Comparatively short and thick, 4-jointed.	Comparatively short and thick, 4-jointed.	Comparatively long and thin or short and thick, 4-jointed.
In all three cases shorter than the head.		
Segmentation.—Not distinct.	Fairly distinct.	Not distinct.
Furcula.—Consists of 4 segments with pair of abdominal appendages (?) fused with the manubrium. Mucro proximally deeply concave, distally lanceolate, non-dentate.	Consists of 4 segments. Mucro somewhat spatulate, non dentate.	Consists of 3 segments. Mucro lanceolate and dentate.
Ventral tube.—Simple.	Simple.	Sub-clavate with a posterior lobe, and tuberculate processes.
Eyes and post-antennal organs.—Absent.	Absent.	Absent.
Tracheae and Tenent Hairs.—Absent.	Absent.	Absent.

Amerus normani, n. gen. et sp.

Pl. VI, figs. 1-5.

Body globular and almost naked, a few hairs round the mouth, dorsally on the head and thorax and on the antennae, limbs and abdomen. The ground colour is a milky-white, with a little reddish-brown colouring dorsally and laterally, giving the body a somewhat mottled appearance. Head vertical and not very distinct from the thorax. Thorax longer than the abdomen. Segmentation

very indistinct. Eyes and post-antennal organs absent. Antennae short and thick, four-jointed, the distal segment the longest. Legs long and slender, articulating ventro-laterally. Each foot terminates in two claws, the upper of which is long and curved, and has a long, fine tooth (pseudonychium) at each side. Under claw short and broad, with a short, blunt tooth on its inner side. No anal tubercle. Furcula consists of four segments, with stout manubrium; what appear to be a vestigial pair of abdominal appendages are attached to the latter. Mucro somewhat spatulate, terminating in a solid lanceolate piece. No tenent hairs.

Length.—0.3 mm.

Hab.—Berkhamsted, under flower pots in a greenhouse, also under decaying wood by the side of a footpath.

Undoubtedly a very primitive form of Collembola.

We have much pleasure in associating the name of the Rev. Canon A. M. Norman, F.R.S., with this interesting species, to whom we are greatly indebted for his kindness in permitting us to make every use of his grounds for collecting purposes and for other assistance.

Genus **Neelus**, Folsom.

Psyche, 1896, vol. vii, pp. 391-392, plt. 8; ibid., 1901, vol. ix, pp. 219-222, plt. 2.

Body globular and almost naked; prothorax slightly reduced dorsally, mesothorax not reduced, metathorax conspicuously long. Abdomen swollen before the manubrium. Head ovate horizontal or subhorizontal, broadly articulated. Thorax longer than abdomen. Anal tubercle absent. Eyes and post-antennal organs absent. The antennae are short, consisting of four segments. Legs long and slender, both claws present on feet. Furcula composed of three segments twice as long as the antennae; manubrium stout, distally bifid; dentes cylindrical in lateral aspect; mucrones elongate lanceolate with serrated edges. Setae short and few. Ventral tube sub-clavate, with a posterior lobe and tuberculate processes.

N. murinus, Folsom.

Psyche, 1896, vol. vii, pp. 391-392, plt. 8.

"General colour ochraceous-buff, in alcoholic specimens ochraceous-orange; when young, white with a dorsal longitudinal median ill-defined buff stripe; head paler; antennae, legs and furcula white. Head horizontal, in lateral view ovate, half as long as body, smooth, anteriorly with short setae. Eyes absent. Antennae

shorter than the width of the head, not geniculate, slender, segments four, their respective lengths as 1, 3, 5, 5; basal segment globose, naked; second subcylindrical, sparsely hairy apically; third cylindrical, subpetiolate, more hairy; terminal segment long-conical, with hairs curving towards the notched apex. Labrum and labium projecting, with stout setae. Mandibles with long, falcate-oblong apex; terminal tooth long, sinuate within; lower incisive teeth small, three and four, compressed; below the base of the apex is a prominent rounded lobe directed forward; molar surface little convex, minutely denticulate, bounded on one side by a longitudinal row of four, or three large, blunt teeth, respectively dorsal and ventral on the right and left mandibles; molar surface with a slight posterior lobe. Maxillae with a conspicuous, dorso-external, curved acuminate claw; ventral and internal to this, a wavy, linear process bearing on distal half an external comb of long teeth; remainder of maxilla composed of two large, oblong, concaved appendages, each with four or five ribs terminating in as many teeth on the anterior truncated margin. Body seen from above oval, smooth; in profile with high-arched dorsal outline; smooth excepting a few bristles on the inconspicuous anal tubercle. Prothorax compressed, broadly articulated with the head. Ventral surface white, much swollen before the manubrium. Ventral tubes equal to dentes in length, cylindrical, crenate anteriorly, one-lobed posteriorly near base, ending in two semi-globose papillate tubercles. Legs slender, about as long as furcula, scarcely bristly except on tibia. Superior claw as long as third antennal segment, slender, internally sinuate with one sharp tooth one-third from apex; a linear pseudonychium, as long as the inferior claw, arises from either side the base of the external margin of superior claw. Inferior claw less than half the other in length, uniformly tapering, scarcely curving with the superior claw, smooth, not toothed; tenent hairs absent. Furcula short, scarcely reaching mesothorax; segments ventrally as 1, 1.5, 1; manubrium stout, swollen, with a few ventral hairs and sinuate distal articulation; dentes laterally a little tapering, distally with five large, lateral teeth at intervals, three being external and two internal, also a long subapical ventral bristle, and an evident, blunt-conical, apical lobe on either side the base of the mucro; mucrones laterally narrowly lanceolate, deeply concave ventrally with each edge distinctly serrate and with simple apex.

Maximum length, 0.7 mm."

Hab.—Berkhamsted. Under flower pots in a greenhouse, also under sticks in a wood.

EXPLANATION OF PLATE VI.

Illustrating Messrs. Collinge and Shoebotham's paper on "Description of a New Genus of Collembola of the Family *Neelidae*, Folsom."

Fig. 1.—*Amerus normani*, gen. et sp. nov. Drawn from mounted specimen.

Fig. 2.— ,, ,, Lateral view of the right antenna.

Fig. 3.— ,, ,, Claw of 3rd foot.

Fig. 4.— ,, ,, Extended furcula seen from below, showing pair of vestigial abdominal appendages. *v. app.*

Fig. 5.— Mucro seen from above.

AMERUS NORMANI, gen. et sp. nov.

REVIEWS.

Bateson, W.—Mendel's Principles of Heredity. Pp. xiv + 396, 6 plts., 37 figs. and 3 portraits. Cambridge: The University Press, 1909. Price 12s. net.

The story of Mendelism is here set forth with a fulness and lucidity that all who are, or wish to be, students of the subject will hail with delight.

It is very largely owing to the enthusiasm and work of Professor Bateson that the subject has reached the position it now occupies in the minds of biological investigators. It matters little for the present moment whether or not the work which the author has stimulated will bear the later scrutiny of strict criticism; indeed, the time is not ripe for such; further experimentation is what is most needed, in spite of the great mass of evidence which Professor Bateson sets forth. Fortunately the work already achieved has been spread over a wide range of subjects, many of great economic importance, and further and extended work will, in all probability, lend further support to the Mendelian position

The author states in his preface that the object of his book "is to give a succinct account of discoveries in regard to Heredity made by the application of Mendel's method of research. Following the clue which his long-lost papers provided, we have reached a point from which classes of phenomena, hitherto proverbial for their seeming irregularity, can be recognized as parts of a consistent whole. The study of Heredity thus becomes an organised branch of physiological science, already abundant in results, and in promise unsurpassed."

Such an account he has given, together with many interesting biographical details of Mendel, and an admirable bibliography of the subject.

For these and the many other features set forth in this work naturalists generally will be deeply grateful. No one interested in biological thought can afford to neglect a book beautifully written, full of interest and bristling with suggestions for further investigations.

W. E. C.

Deegener, P.—Die Metamorphose der Insekten. Pp. ii + 56. Leipzig n. Berlin: B. G. Teubner, 1909. Price 2s.

In this small volume of 56 pages the author gives a valuable and suggestive discussion on the ever fresh and fascinating subject of insect transformation. After a short sketch of the conflicting views of those

who regard the larvae of the higher insects as representing a true phylogenetic stage, and of those who consider larval structures to be special, temporary adaptations for the early life of the individual, Dr. Deegener points out the varying relations that occur between the larval and imaginal organs; thus normal insectan organs well-developed in the larva, but reduced or wanting in the imago, are "primitive," while structures specially developed for larval life and absent or normally developed in the perfect insect, are "provisional." From such facts the author supports in his subsequent discussion on the phylogeny of metamorphosis, the view that the larva among the higher insects has been specialized—even if by degeneration—and has thus become markedly unlike the imago. In this conclusion he is in agreement with most modern students of the life of insects. An interesting discussion of the pupal stage concludes the work, in which attention is called to the phylogenetic import of the ephemerid sub-imago.

Dr. Deegener's arguments are well worthy of attention from all earnest students.

G. H. .

Lankester, Ray.—A Treatise on Zoology. Part vii. Appendiculata. Third fascicle Crustacea, by W. T. Calman. Pp. viii + 346, 194 figs. London: Adam and Charles Black, 1909. Price 15s. net.

To this already valuable treatise Dr. Calman adds a volume upon the Crustacea, which is a most valuable epitome of Crustacean morphology.

The author first succinctly summarises our ideas upon the Crustacea as a Class, and then passes on to review the various Orders. From the standpoint of either the morphologist or systematist little seems to have been omitted, and one wonders how ever he has so thoroughly summarised the whole of the Orders in so few pages.

Specially interesting are the accounts of the Cirripedia, Syncarida, Tanaidacea, and Isopoda, whilst the remaining Orders are treated in a manner leaving little if anything to be desired.

We look forward with considerable interest to the remaining volumes dealing with the Appendiculata, in the meantime students of zoology in general, and carcinologists in particular are under a debt of gratitude to the author for having provided them with an admirable text-book, replete with the very latest information, and carefully and concisely written.

W. E. C.

CURRENT LITERATURE.

I.—General Subject.

Ballou, H. A.—Millions and Mosquitos. W.I. Bull., 1909, vol. ix, pp. 382-390, 4 figs.

Cooley, R. A.—Photomicrography of the *Diaspinae*. Journ. Econ. Entom., 1909, vol. 2, pp. 95-99.

Felt, E. P.—Control of Household Insects. N.Y. State Mus., Bull. 129, 1909, pp. 1-47, figs. 1-34.

The well-known works of Howard and Marlatt, John B. Smith, and Froggatt leave little to be said upon the subject of household insects, but in view of the importance of the subject it is just as well that it should be said often, and Dr. Felt's useful bulletin once more emphasises the seriousness of the subject regarded from the health standpoint.

Hood, C. E.—Types of Cages found useful in Parasitic Work. Journ. Econ. Entom., 1909, vol. 2, pp. 121-124, plts. 3, 4.

Howard, L. O.—House Fleas. U.S. Dept. Agric., Bur. of Entom., Circ. No. 108, 1909, pp. 1-4, 2 figs.

Sanders, J. G.—Notes on Insect Photography and Photomicrography. Journ. Econ. Entom., 1909, vol. 2, pp. 89-95.

Smith, J. B.—The House Mosquito, a City, Town and Village Problem. New Jersey Agr. Exp. Stat., Bull. 216, 1908, pp. 1-21, 9 figs.

Webster, F. M.—The Importance of Proper Method in Entomological Investigations. Journ. Econ. Entom., 1909, vol. 2, pp. 99-108.

II.—Anatomy, Physiology, and Development.

Nuttall, G. H. F., Cooper, W. F., and Robinson, L. E.—On the Structure of the Spiracles of a Tick—*Haemaphysalis punctata,* Canestrini and Fanzago. Parasitology, 1908, vol. i, pp. 347-351, plts. xxii, xxiii.

Stephens, J. W. W.—Observations on the Hooklets of *Cysticercus cellulosae* in Man. Ann. Trop. Med. and Par., 1909, vol. ii, pp. 391-395, figs. 1-4.

III.—General and Systematic Biology, and Geographical Distribution.

Bagnall, R. S.—The Bristle-tails (Thysanura) of the Derwent Valley. Trans. Vale of Derwent N. Field Club, 1908, vol. 1, pp. 26-30.

Mr Bagnall brings to light again the *Praemachilis brevicornis* (Ridley).

Bagnall, R. S.—Preliminary Description of a new and injurious Thrip. Entom. Mon. Mag., 1909, p. 33.

Beare, T. H., and Evans, W.—Coleoptera from Moles' Nests in the South-East of Scotland. Ann. Scot. N.H., 1909, pp. 86-91.

Bezzi, M.—Le specie dei generi *Ceratitis, Anastrepha e Dacus*. Boll. Lab. Zool. gen. e agrar. Portici, 1909, vol. iii, pp. 273-313, figs. 1-3.

A very hopeful review and revision with an excellent bibliography.

Cockerell, T. D. A.—Two Fossil Bees. Entom. News, 1909, pp. 159-161.

Cockerell, T. D. A.—Some New Bees, and other Notes. Canadian Entom., 1909, pp. 128-131.

Cockerell, T. D. A.—Fossil Insects from Florissant, Colorado. Bull. Amer. Mus. N.H., 1909, vol. xxvi, pp. 67-76, plt. xvi.

Collinge, Walter E.—The Life-history and Habits of the Woolly Aphis (*Schizoneura lanigera,* Hausm.). Journ. Cooper Research Lab., 1909, pp. 28-37, 3 figs.

Davis, J. J.—Biological Studies on three Species of *Aphididae*. U.S. Dept. Agric., Bur. of Entom., No. 12, pt. viii, 1909, pp. 123-168, 4 figs.

Essig, E. O.—*Aphididae* of Southern California. 1. Pomona Journ. Entom., 1909, vol. i, pp. 1-10, 7 figs.

Essig, E. O.—Notes on *Coccidae*. 1. Pomona Journ. Entom., 1909, vol. i, pp. 11-14, 3 figs.

Felt, E. P.—Gall Midges of the Goldenrod. Ottawa Nat., 1909, vol. xxii, pp. 245-249.

Gowdey, C. C.—The *Aleyrodidae* of Barbados. W.I. Bull., 1909, vol. ix, pp. 345-360, 18 figs.

Lefroy, H. M.—Notes on Indian Scale Insects (*Coccidae*). Mem. Dept. Agric. India, Entom. Ser., 1908, vol. ii, no. 7, pp. 111-137, plts. x-xii.

An interesting paper giving many details and life-histories, and well illustrated.

It is a great pity that this excellent series of publications are not edited in a better manner. In the one before us we note that specific names are spelt with a capital letter in some places, and in others with a small

letter; that all the names of authorities are enclosed in brackets; that the plates are sometimes numbered at the top right-hand corner, and in other cases at the top and in the middle. Greater uniformity is highly desirable.

Masi, L.—Contribuzioni alla conoscenza dei Calcididi Italiani. Boll. 1909, vol. iv, pp. 1-37, 29 figs.

The following new species are described and figured: *Encyrtus vinulae, Habrocytus hyponomeutae, Prospaltella lutea, Encarsia partenopea, Cocoophagus niger,* and *Physcus testaceus.* Figures and full descriptions are also given of other species.

Nalepa, A.—Neue Gallmilben (30 Fortsetzung). Sitz. Ak. Wien, 1909, No. x, pp. 1, 2.

The author describes *Eriophyes crassipunctatus* and *E. magalonyx,* both new sub-species of *E. machrochelus,* Nal., also *E. paderineus,* n.sp. and *E. protrichus. E. fraxinivorus* is a new name proposed for *E. fraxini* (Karp. 1884, non Garman, 1882), and *E. ulmicola* for *E. ulmi,* Nal., 1890 (non Garman, 1882).

Nalepa, A.—VI Eriophyiden. Denks. Akad. Wiss. Wien, 1908, Bd. lxxxiv, pp. 1-14, Tafn ii, iii.

Nalepa, A.—Eine Gallmilbe als Erzeugerin der Blattgallen von *Cinnamomum zeylanicum,* Breyn. Marcellia, 1909, vol. viii, pp. 3-6.

Eriophyes doctersi, n.sp.

Newell, W.—The Life-history of the Argentine Ant, *Iridomyrmex humilis,* Mayr. Journ. Econ. Entom., 1909, vol. 2, pp. 174-192, plts. 5-7, and 4 figs.

Rehn, J. A. G.—On Brazilian Grasshoppers of the Subfamilies *Pyrgomorphinae* and *Locustinae* (*Acridinae* of Authors). Proc. U.S. Nat., Mus., 1909, vol. xxxvi, pp. 109-163, 38 figs.

Silvestri, F.—Tisanuri raccolti da L. Fea alle isole del Capo Verde, alla Guinea Portoghese e alle isole S. Thomè, Principe e Fernando Poo. Ann. Mus. Civ. Storia Nat. Genova, 1908 (s.3), vol. iv, pp. 133-187, figs. i-xxiv.

The author describes 6 new species from Cape Verde Is., 5 from Portuguese Guinea, 3 from Is. of St. Thomas, 1 from Princes Is., and 5 from the Is. Fernando Po. From the latter island 3 new genera are described, viz., *Olarthrocera, Monachtinella,* and *Subnicoletia.*

The descriptions are illustrated by numerous figures.

Silvestri, F.—Descrizioni preliminari di varii Artropodi, specialmente d'America. R. Acc. d. Lincei, 1909, vol. xviii, pp. 7-10.

Prof. Silvestri describes the following new genera and species: *Projapyx incomprehensus, Symphylurinus* (gen. nov.) *grassi, Anajapyx mexi-*

canus, from material in the United States National Museum; also a new Proturan from New York, *Eosentomon wheeleri* and var. nov. *mexicanum* of that species.

The *Acerentomon minimum* of Berlese he places in a new genus to which he gives the name *Proturentomon.*

Smith, R. I.—Biological Notes on *Murgantia histrionica,* Hahn. Journ. Econ. Entom., 1909, vol. 2, pp. 108-114.

IV.—Agriculture and Horticulture.

Baker, C. F.—Plant Louse Parasites. 1. Pomona Journ. Entom., 1909, vol. i, pp. 22-25.

Ball, E. D.—Is Arsenical Spraying killing our Fruit trees? Journ. Econ. Entom., 1909, vol. 2, pp. 142-148.

Ballou, H. A.—Insect Pests of Cacoa. Imp. Dept. Agric. W.I., No. 58, 1909, pp. iv + 26, 12 figs.

Barlow, W. H.—Copper as a Fungicide. Journ. Cooper Research Lab., 1909, pp. 43-50.

Chittenden, F. H.—The Pea Aphis (*Macrosiphum pisi,* Kalt.). U.S. Dept. Agric., Bur. of Entom., Circ. No. 43, 2nd ed., 1909, pp. 1-10, 7 figs.

Chittenden, F. H.—The Common Red Spider (*Tetranychus bimaculatus,* Harvey). U.S. Dept. Agric., Bur. of Entom., Circ. No. 104, pp. 1-11, figs. 1-4.

Chittenden, F. H., and Russel, H. M.—The Semitropical Army Worm (*Prodenia eridania,* Cram.). U.S. Dept. Agric., Bur. of Entom., Bull. No. 66, pt. v, 1909, pp. 53-70, 4 figs.

Collinge, Walter E.—The Use of Lime in Agriculture, with special reference to its application to Finger and Toe Disease in Turnips, etc. Journ. Cooper Research Lab., 1909, pp. 15-27, 2 figs.

Cook, A. J.—The Red Scale (*Chrysomphalus aurantii,* Mask.). Pomona Journ. Entom., 1909, vol. i, pp. 15-21, 5 figs.

Eriksson, J.—Gooseberry Mildew and Gooseberry Cultivation. Journ. Roy. Hort. Soc., 1908, vol. xxxiv, pp. 469-472.

Fletcher, J.—Report of the Entomologist and Botanist. 1907-1908. App. to the Rpt. Min. of Agr., Ottawa, 1908, pp. 183-213, 1 plt.

Fuller, Claude.—The English Sparrow. Natal Agric. Journ., 1909, pp. 76-80, 1 fig.

Fuller, C.—Second Annual Report of the Committee of Control of the South African Central Locust Bureau. Pp. iv + 86. Cape Town, 1909.

Fortunately we scarcely understand in the British Isles what a serious plague of insects means, but the Report before us vividly brings home to us what such means to other countries. Mr. Claude Fuller, the Government Entomologist of Natal, informs us that the total funds expended in South Africa in connection with the past season's work on locust destruction, was, approximately, £40,000, and while the work is not expected to lead to the total eradication of these insects, it undoubtedly has diminished their numbers, and further the knowledge acquired cannot fail to prove a most valuable asset for the future.

Garman, H.—The Army Worm. Kentucky Agric. Exp. Stat., Bull. No. 137, 1908, pp. 431-449, 16 figs.

No indication of what species this is, from the figures we take it to be *Leucania unipuncta,* Haworth.

Gates, B. N.—A Method of securing Apicultural Statistics. Journ. Econ. Entom., 1909, vol. 2, pp. 117-120.

Hinds, W. E.—Carbon di-sulphide fumigation for Grain infesting Insects. Journ. Econ. Entom., 1909, vol. 2, pp. 161-168.

Hunter, W. D.—The Boll Weevil Problem. U.S. Dept. Agric., Farmers' Bull. No. 344, 1909, pp. 1-46.

McAlpine, D.—The Stinking Smut of Wheat. Journ. Dept. Agric. Victoria, 1909, vol. vii, pp. 171-175.

Mally, C. W.—The Tok-Tokje (*Psammodes* sp.) as a grain pest. Agric. Journ. C. of G.H., 1909, vol. xxxiv, pp. 416-418, 3 figs.

Marlatt, C. L.—How to Control the San Jose Scale. U.S. Dept. Agric., Bur. of Entom., Circ. No. 42, 5th ed., 1909, pp. 1-7.

Moulton, Dudley.—The Orange Thrips. U.S. Dept. Agric., Bur. of Entom., Tech. Ser., No. 12, pt. vii, 1909, pp. 119-122, plt. viii.
Euthrips citri, n.sp.

Parrott, P. J.—Tree Crickets and Injury to Apple Wood. Journ. Econ. Entom., 1909, vol. 2, pp. 124-127.

Phillips, E. F.—Means whereby the Economic Entomologist can advance Apiculture. Journ. Econ. Entom., 1909, vol. 2, pp. 115-117.

Phillips, E. F.—The Status of Apiculture in the United States. U.S. Dept. Agric., Bur. of Entom., Bull. No. 75, pt. vi, pp. 59-80.

Quaintance, A. L.—The Self-boiled lime-sulphur mixture as a Summer treatment for the San Jose Scale. Journ. Econ. Entom., 1909, vol. 2, pp. 130-135.

Sackett, Walter G.—Some Bacterial Diseases of Plants. Colorado Agric. Exp. Stat., Bull. 138, 1909, pp. 1-23.

Sanderson, E. D.—Notes on recent experiments for the control of the Codling Moth. Journ. Econ. Entom., 1909, vol. 2, pp. 135-142.

Schoene, W. J.—The Tussock Moth in Orchards. N.Y. Agr. Exp. Stat., Geneva, Bull. No. 312, 1909, pp. 39-49, plts. i-iii.

Scott, W. M., and Rorer, J. B.—Apple Blotch, a serious disease of Southern Orchards. U.S. Dept. Agric., Bur. Plant Indus., Bull. No. 144, 1909, pp. 1-28, plts. i-vi.

Stewart, F. C., and Others.—Potato Spraying Experiments in 1908. N.Y. Agr. Exp. Stat., Geneva, Bull. No. 311, 1909, pp. 1-38.

Stockdale, F. A.—Fungus Diseases of Cocoa-Nuts in the West Indies. W.I. Bull., 1909, vol. ix, pp. 361-381.

Summers, H. E.—The Distribution of San Jose Scale in Iowa. Journ. Econ. Entom., 1909, vol. 2, pp. 127-129.

Taylor, E. P.—An experiment in the Control of Curculio on Peach. Journ. Econ. Entom., 1909, vol. 2, pp. 154-160.

Titus, E. G.—The Alfalfa Leaf-Weevil. Journ. Econ. Entom., 1909, vol. 2, pp. 148-154.

Williamson, S.—A Note on the Action of Caustic Soda, Paraffin, and Tar Oils on Fruit Trees. Journ. Cooper Research Lab., 1909, pp. 38-42, 3 figs.

Wilson, H. F.—The Peach-tree Barkbeetle (*Phlaeotribus liminaris*, Harr.). U.S. Dept. Agric., Bur. of Entom., Bull. No. 68, pt. ix, 1909, pp. 91-108, plts. x-xii and 3 figs.

V.—Forestry.

Stebbing, E. P.—The Sal Bark-Borer. (*Sphaerotrypes siwalikensis*, Steb.). Imp. Dept. Forestry, Leaflet No. 1, 1908, pp. 1-8, 5 figs.

Stebbing, E. P.—The Teak Defoliator. (*Hybloea puera*, Cram.). Ibid., Leaflet No. 2, pp. 1-5, 5 figs.

Stebbing, E. P.—The Teak Leaf Skeletoniser. (*Pyrausta machaeralis*, Wlk.). Ibid., Leaflet No. 3, pp. 1-7, 2 figs.

VI.—Fisheries.

Shipley, A. E.—Note on the occurrence of *Triaenophorus nodulosus*, Rud. in the Norfolk Broads. Parasitology, 1908, vol. i, pp. 281, 282, 1 fig.

VII.—Medicine.

[Anon.]—The Röntgen Ray Treatment of Ringworm. Lancet, 1909, May 15th, pp. 1399-1400.

Duval, C. M., and Todd, J. L.—A Note on the Cultivation of *Spirochalta duttoni*. Lancet, 1909, March 20th, pp. 834, 835.

Howard, L. O.—Economic Loss to the People of the United States through Insects that Carry Disease. U.S. Dept. Agric., Bur. of Entom., Bull. No. 78, 1909, pp. 1-40.

Dr. Howard points out that "the United States is just awakening to the knowledge of the disastrous results following a lack of appreciation of the danger arising from the unchecked development of mosquitoes and the typhoid fly, and it is hoped that the bulletin will not only emphasise this danger, but will also lend support to movements, both local and wide-spread, towards the destruction (often so easy) of these carriers of disease."

He proposes the name "typhoid fly" as a substitute for the name "house fly," which insect people have altogether too long considered as a harmless creature, whereas it is a most dangerous one from the standpoint of disease. "That a creature born in undescribable filth and absolutely swarming with disease germs should practically be invited to multiply unchecked, even in great centres of population, is surely nothing less than criminal."

We commend this bulletin to the notice of all Medical Officers of Health.

Lane, A. C.—Intestinal Animal Parasites in Monghyr. Indian Med. Gaz., 1909, vol. xliv, pp. 131-134, figs. 1-21.

Manson, P., and Sambon, L. W.—A Case of Intestinal Pseudo-Parasitism due to *Chilodon uncinatus* (Blochmann). Lancet, 1909, March 20th, pp. 832-834, 7 figs.

Shipley, A. E.—A Cause of Appendicitis and other Intestinal Lesions in Man and other Vertebrates. Parasitology, 1908, vol. i, pp. 263-279.

VIII.—Animal Diseases.

Collinge, Walter E.—Note on Aphids attacking Sheep, Cattle, and Horses. Journ. Cooper Research Lab., 1909, pp. 51-52.

Day, L. E.—Embryonal Adenosarcoma of the Kidney in Swine. U.S. Dept. Agric., 24th Ann. Rpt. Bur. of An. Ind., 1909, pp. 247-257, figs. 32-39.

Francis, A.—The Eradication of Scab. Agric. Journ. C. of G.H., 1909, vol. xxxiv, pp. 367-375.

Hignell, H.—The Eradication of Scab. Agric. Journ. C. of G.H., 1909, vol. xxxiv, pp. 264-268.

Jowett, W.—Chicken Pox, Fowl Pox, or Sore Head. Agric. Journ. C. of G.H., 1909, vol. xxxiv, pp. 270-276, 4 figs.

Melvin, A. D.—The Eradication of Tuberculosis in Cattle. U.S. Dept. Agric., 24th Ann. Rpt. Bur. of An. Ind., 1909, pp. 209-214.

Melvin, A. D., and Mohler, J. R.—Dermal Mycosis associated with Sarcoptic Mange in Horses. U.S. Dept. Agric., 24th Ann. Rpt. Bur. of An. Ind., 1909, pp. 259-277, plt. vi, figs. 40-45.

Mohler, J. R.—The Effect of Certain Diseases and Conditions of Cattle upon the Milk Supply. U.S. Dept. Agric., 24th Ann. Rpt. Bur. of An. Ind., 1909, pp. 145-159.

Mohler, J. R., and Washburn, H. J.—Tuberculosis of Hogs: its Cause and Suppression. U.S. Dept. Agric., 24th Ann. Rpt. Bur. of An. Ind., 1909, pp. 215-246, plts. ii-v.

Ross, E. H.—A Gregarine Parasitic in the Dog Flea, *Ctenocephalus serraticeps*. Ann. Trop. Med. and Par., 1909, vol. ii, pp. 359-363.

Stiles, C. W., and Hassall, A.—Index Catalogue of Medical and Veterinary Zoology. Pts. 22 and 23. U.S. Dept. Agric., Bur. An. Ind., Bull. No. 39, 1909, pp. 1625-1805.

THE

JOURNAL OF ECONOMIC BIOLOGY.

ON THE RELATION OF CERTAIN CESTODE AND NEMATODE PARASITES TO BACTERIAL DISEASE.[1]

By

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Fellow and Tutor of Christ's College, Cambridge, and Reader in Zoology in the University.

"*BY A WORM'S PIN-PRICK.*"

A Lover's Quarrel. R. Browning.

In Volume No. I. of *Parasitology*[2] I described some Nematode worms living in the swim-bladder of certain rainbow trout, taken on the estate of the Hon. Sydney Holland, near Royston. The trout were dying in considerable numbers, being found standing on their heads in the stream in a dead or moribund condition. They were *déséquilibrés,* and seemed "to suffer from some derangement of the swim-bladder; they swim always on the surface on the water and die with their heads downwards and the body almost, if not quite, perpendicular to the surface of the water. They die, as Mr. Holland tells me, not only in deep water, but occasionally in the shallow water of the spawning beds." "Last year, however, during the period of greatest mortality, when six or seven trout were dying a day, until some 50 out of 200 were dead, they never tried to work up stream to the spawning beds, but died in the deep water. The fish seemed to have difficulty about shedding their ova, and it may be that this difficulty is connected with the cause of the mortality, but males died with the same symptoms as females, though not in such large numbers. Since the spawning season finished this year there have been no deaths. Curiously, too, the rainbow trout are alone affected and not the brown trout."

The Nematodes belong to the species *Cystidicola farionis,* Fischer, and their structure has been described by Mr. R. T. Leiper

[1] Read before the Association of Economic Biologists, Oxford Meeting, July 13th, 1909.

[2] "Parasitology," 1908, vol. I, pp. 190-2.

in the same number of "Parasitology." Their presence caused no visible lesions. Here for a time the matter rested. But this summer Mr. G. H. Drew, of the Marine Biological Association, Plymouth, was able to carry the research somewhat further. He investigated some of the trout preserved in formalin, and he paid a visit to Royston to inspect the trout on the spot. I have ventured to quote the following paragraphs from his paper which will shortly appear :—

"In every case from 10 to 30 specimens of *Cystidicola* were present in the swim-bladder, and in many cases a small amount of a fibrino-purulent material was adherent to the walls. Smears of this exudation were made, fixed by heat, and stained with methylene blue. Under the microscope these slides showed many leucocytes, fibrin, and large numbers of bacteria. The leucocytes were somewhat degenerated, but many of them showed phagocytosis: many different forms of bacteria were present. Preparations of the walls of the swim-bladder showed dilatation of the capillaries with transmigration of leucocytes and some fibrin formation. The condition was typically that which would be produced by infection of a serous cavity with bacteria."

"Through the kindness of Mr. Holland I was able to go to Royston and investigate the matter on the spot. Eight fish were caught and dissected, and of these seven were infected with *Cystidicola*. These seven all showed signs of inflammation of the swim-bladder and smears showed the presence of many bacteria and distinct pus formation : the remaining fish, a Brown Trout, was free from *Cystidicola*, and the swim-bladder showed no signs of inflammation, nor could any bacteria be detected."

"In each case, before opening the swim-bladder, the wall was well seared with a red hot seeker, a sterile platinum needle introduced, and sterile, sloped tubes of peptonised fish gelatine were inoculated. The tubes inoculated from the seven infected fish showed a free growth of bacterial colonies in the course of a few days, whilst the one inoculated from the remaining fish, which was free from *Cystidicola*, remained sterile. At least twelve different species of bacteria were present, distinguishable by their shape, form and colour of the colonies, powers of liquefying gelatine, staining reactions, etc."

"The gas from the swim-bladders of two of the infected trout was collected, and an analysis gave—

Carbon dioxide (absorbed by potash) 1.5%.
Oxygen (absorbed by potassium pyrogallate) 0.0%.
Nitrogen (by difference) 98.5%."

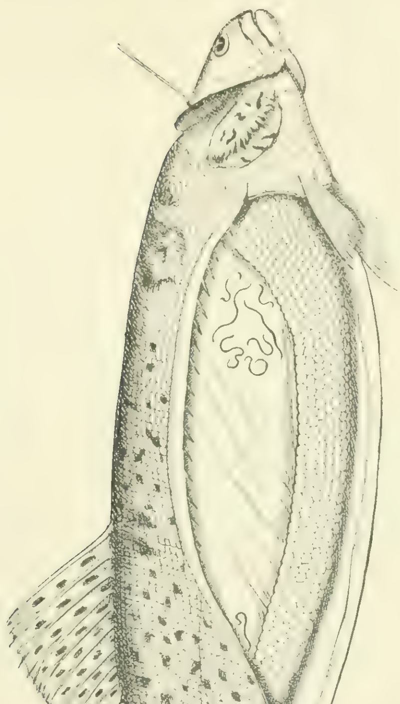

Fig. 1.—A rainbow trout, × $\frac{1}{3}$, opened to show 7 specimens of *Trichostrongylus pergracilis* (Cobbold), in the anterior end of the swim-bladder and one in the posterior. The operculum is hooked up to show specimens of the Trematode, *Octobothrium sagittatum*, Lck., on the gills.

"These fish had been caught and allowed to die in the air, so it is possible that any oxygen present during life may have been used up during the process of asphyxiation. Mr. F. G. Richmond, of the Surrey Trout Farm and United Fisheries Co., Ltd., kindly sent me some healthy fish, uninfected with *Cystidicola,* for purposes of comparison; cultures from the swim-bladders of these fish in every case remained sterile. It would thus seem probable that bacterial infection may be conveyed by *Cystidicolae* in their migration into the swim-bladder of the trout, and it is possible that death may be caused by the introduction of pathogenic organisms in this manner. It is easily conceivable that any agent causing acute inflammation of the swim-bladder with the consequent dilatation of its blood-vessels, would produce excessive liberation of dissolved gases from the blood, and thus by undue distention of the swim-bladder disturb the equilibrium of the fish."

"With regard to the mode of entry of the parasite, it is possible, as Shipley (*loc. cit.*) suggests, that they enter along the ductus pneumaticus, but it is also possible that in some cases they migrate directly from the intestine. I recently examined a roach containing *Cystidicolae* both in the intestine and swim-bladder, in which the parasite could be seen in various stages of development encysted in the intestinal wall, mesentery, and subperitoneal tissue, and so apparently making its way from the intestine to the swim-bladder directly through the tissues."

It, however, now seems clear from this last observation that the Nematode enters the swim-bladder by piercing through the intestinal wall and traversing the intermediate tissues, and it seems certain that the numerous bacteria which are found in the air-bladder have been brought there by the migrating Nematodes. It is a clear case of bacterial disease arising from inoculation by a Nematode.

During the last three years I have been working on parasites of the grouse in connection with the Grouse Disease Enquiry. At times the grouse were very heavily infected both with Cestodes and with Nematodes, the former being found in the intestine, the latter both in the intestine and in the paired caeca. The grouse is remarkable amongst birds for the large size of these diverticula, the two together being at least as long as the whole of the rest of the alimentary tract. It would seem as if the whole of the absorption of the nutritive food takes place in these organs. Each caecum, in a badly infected bird, may contain thousands of the thread-worm *Trichostrongylus pergracilis* (Cobbold), and such heavy infection is accompanied by changes, inflammation, or an atrophy, in the thick-

ness of the caecal walls. Following on these changes is a decrease in the power of absorption. Now, we have found that the Nematode *T. pergracilis* winds its thin anterior end around the papillae on the inner surface, and may in this way interfere with the normal functions of the mucosa, but Dr. Leiper has also satisfied himself that the thin anterior end actually pierces the mucous lining of this part of the alimentary canal. By this breaking of the continuity of the mucous lining, the numerous bacteria which swarm in the lumen of the alimentary tract gain access to the deeper tissues. These bacteria are harmless whilst in the alimentary canal, but set up pathogenic change when they reach the deeper tissues, and Dr. Cobbett and Dr. Graham Smith have clearly shown that when the infection in the caeca of the grouse, caused by the presence of *T. pergracilis,* passes a certain limit, bacteria exist in large numbers in the liver, lungs, and other tissues of the body. Below this limit bacteria in these tissues are few and far between, and one must not forget that isolated bacteria occasionally make their way through the tissues without help from the grosser intestinal parasites. These are probably quickly absorbed, and it is only when their numbers are so large that the phagocytes and other protective cells are unable to cope with them that disease is set up.

Finally, we have the species of *Strongylus quadriradiatus*, recently described by E. C. Stevenson.[1] It occurred in considerable numbers in the intestines of a flock of fancy pigeons which had been almost destroyed by a malady of unknown origin early in 1904. In his article upon this epizootic, Stevenson points out that the presence of a few Nematodes in the caecum of the pigeon causes little harm. If, however, the thread-worms exist in large numbers, disease becomes manifest. This Stevenson attributes to two causes: the first is the loss of blood: but there is, I think, little or no evidence that these Nematodes live on blood. The second cause is the piercing of the walls of the intestine,[2] which permit the bacteria of the contents of the alimentary canal to make their way into the peritoneal cavity, where they set up peritonitis. Evidence is gradually accumulating as to the occurrence of this, and some of the French authorities even think that such a perforation, made as a rule by *Trichocephalus dispar,* is one of the more common, if not the most common, cause of appendicitis in man. The presence of these worms further sets

[1] U.S. Board of Agriculture, Bureau of Animal Industry, Circular XXXVII, 1904. This will probably prove to be a *Trichostrongylus.*

[2] An actual perforation of the membrane is not in all cases necessary. There are examples of bacteria traversing the wall or parts of the wall of the alimentary canal which have been locally or temporarily weakened in some way.

up an inflamed, catarrhal condition of the walls of the intestine, which leads to a debilitating diarrhœa, and to general disorders of the digestive system.

In Volume No. I. of *Parasitology*, under the title "A Cause of Appendicitis and other Intestinal Lesions in Man," I drew attention to the numerous cases in which human parasites cause a discontinuity in the lining membranes of the various spaces of the body, and thus allow the access of the intestinal flora to the deeper tissues. The cases I recorded were taken from many sources, but the majority of them came from a paper by Weinberg, published in the *Annales de l'Institut Pasteur*. I regret to say I entirely overlooked a paper by Professor R. Blanchard, published in the *Archives de Parasitologie*, 1906, in which he forestalled to a great extent what I had to say, but I was happy to find, on reading his paper, that the conclusions which I have arrived at are very similar to those that this great master of Parasitology has put forth.

One interesting case quoted in my paper was that of infecting certain apes with typhoid bacilli. In some cases both Grünbaum and Soloukha had failed to give monkeys typhoid, but in the cases mentioned by Weinberg certain apes which were infested with Cestodes and also with *Trichocephalus* took the disease, the passage of the bacillus being apparently aided by the lesions in the intestinal wall caused by the burrowing of the heads of these creatures.

Weinberg[1] concludes his thesis by saying that his microscopic sections show that:—

(i.) The tape-worm, by fixing itself on the intestinal mucosa, or lining membrane of the intestine, sets up an intense congestion at the point of fixation;

(ii.) At the same time it makes such bacteria as are to be found on its suckers adhere to this point of the intestinal mucosa, and it further imprisons between its suckers and the intestinal wall such bacteria as existed before on this portion of the mucosa;

(iii.) A considerable number of leucocytes (white blood corpuscles) make their way to the surface of the mucosa and take up the bacteria;

(iv.) At other times, the bacteria penetrate into the thickness of the mucosa and set up inflammatory changes which may end in one of those ulcerations which are so often found at the point of fixation of the tape-worm.

It seems then that Weinberg does not allow that the Cestode head breaks the continuity of the mucosa. He does not give precise

[1] Ann. Instit. Pasteur, xxi, 1907, pp. 417 and 533.

details as to the species of "ténia" he is dealing with, and it may very well be that the unarmed species do not penetrate the lining of the intestinal wall. But whoever will study Piana's paper[1] will, I think, have little doubt that in such genera of tape-worm as *Davainea,* and I think we may add *Hymenolepis,* there is a distinct solution of the continuity of the lining mucosa of the host.

I am not sure quite how much injury to the mucosa is required to admit germs which are harmless within the gut lumen, but pathogenic when they gain free access to the blood or tissues, especially when the latter have been injured. Without doubt the passage of the bacteria which set up intestinal disease is immensely aided by any agent which causes a lesion in the mucosa. Such lesions are normally caused in man,—apart from any irritating substances he may swallow with his food, such, for instance, as the powdered diamond or glass which is said to have been used in Italy in the palmy days of poisoning—by entozoa.

It is sometimes urged that Chinamen, Abyssinians, and other foreigners whom Englishmen are apt to group together under the term "natives," and who are notoriously rich in entozca, seldom suffer from appendicitis or peritonitis, but we must not forget the fact that some people and races are much more "tolerant" of all sorts of parasites, bacterial and others, and when infected, suffer far less than do others who are more susceptible to their action.

In my essay on "A Cause of Appendicitis," from which I am freely quoting, I confined my attention in the main to but three human intestinal parasites—*Oxyuris vermicularis* (Lin.), *Ascaris lumbricoides* (Lin.), and *Trichocephalus trichiurus* (Lin.)—all of them Nematodes. There are, however, many more which merit discussion, but these three are from my point of view the most important. Two of these, the *Oxyuris* and the *Trichocephalus,* are comparatively common, and the latter is probably much more common than is usually recognized. The family doctor knows how common *Oxyuris* is. Comparatively few children escape it, and it attacks the rich and the poor, the apparently well-cared-for and the neglected with complete indifference. A short time ago I found three specimens of *Oxyuris* in the extirpated appendix of a patient who was quite ignorant, as were her parents, that she harboured these worms.

Further I confined my attention largely to appendicitis; there are, however, many other diseases whose presence is associated with entozoa in the alimentary canal, *e.g.*, certain forms of diarrhœa; some

[1] Mem. Ac. Sci. Instit. Bologna, 4 Ser. II, p. 387.

of these have been described by Weinberg, who has investigated the relations of many more parasites to the intestinal wall than are considered here. All tell the same tale.

When one attempts to discuss the possible origin of appendicitis from entozoa with a surgeon or indeed with a pathologist, one is met with the reply that hundreds and thousands of appendices are removed annually and no parasite is seen in them. But are they carefully looked for and are they looked for by someone accustomed to see entozoa? How many medical men are acquainted with the appearance of even our commoner human parasites? It struck me as rather remarkable that one of my most promising pupils, who is entitled to place M.R.C.S., L.R.C.P., after his name, judging by a letter to the *British Medical Journal*,[1] should have referred so characteristic and so common a parasite as "*Trichocephalus dispar*" (= *Trichocephalus trichiurus* (Lin.)) to an expert before he was sure what it was he had found; but nowadays but few medical students are taught anything about entozoa. There is an extreme difficulty of seeing *Hymenolepis microps* and *Trichosoma longicolle* in the intestine of the grouse. Their complete transparency made them, when alive, invisible, and for years they have eluded the observation of the numerous competent observers who have dissected that much dissected bird. To some extent this is not true of the living *Trichocephalus*, a near ally to *Trichosoma*, but it is well known that the whip-worm conceals itself in the mucus, and is therefore easily overlooked unless very special care be taken in searching for it. Again, it is a well known fact that most entozoa move about, and the absence of *Trichocephalus* from an extirpated appendix is no proof that one or more may not have been there some time before the operation took place and have given rise to the inflammation and then have "gone on" as the saying is. Especially are they prone to shift their quarters after the death of their host, and this may well explain the difficulty of finding them in post-mortem examinations.

Since the discovery of bacteria and during the important work which has been done on the germ theory of disease during the last forty or fifty years, the grosser human parasites have been rather left in the shade. Before that time it was much more usual to administer vermifuges from time to time. Many of the numerous ailments of children were treated by our medical grandfathers with antihelminthics, and even to-day Sir Patrick Manson recommends that in the tropics and in other places where the intestinal parasites are common, a course of santonin should be administered to children

[1] Brit. Med. Journ., 1906, II, p. 364.

every six months. In spite of the great increase in our knowledge and practice of hygiene, personal cleanness, care in our meat supply, etc., which has so materially lessened the number of cases suffering for instance from the pork or beef tape-worm, I am not convinced that as regards other entozoa, whose entrance into the body is less easily controlled, we keep the inside of our digestive system as clean as our ancestors kept theirs. Our bodies may be but "whited sepulchres, which indeed appear beautiful outward, but are within full . . . of all uncleanness." Still times are changing, and increasing attention is being paid to what I am convinced is a serious factor in certain diseases. The matter is one which in England has received so far but little attention. Looking through the list of the "cloud of witnesses" given in my longer essay, hardly an Anglo-Saxon name occurs. Our knowledge of the relations of the parasite to the intestinal wall is derived mostly from Italian, French and German sources. In the United States, however, there is at least one voice "crying in the wilderness." Professor H. B. Ward[1] having carefully considered the entozoa as germ-carriers and germ-inoculators, says "there has prevailed during recent years among the medical men of this country an exaggerated idea of the unimportance of human parasites. This must now give way to a proper conception of the pathological significance of these organisms, based upon careful investigations of their actual influence upon the host."

Within a very few years the science of medicine has seen the greatest and most sudden advance—comparable only with the discovery of bacteria—which the world has yet witnessed. The discovery of the protozoal origin of many diseases is a factor in the hands of man which will enable him to repeople dark continents and to exploit the riches of the tropics. There is no more interesting chapter in the history of this discovery than that which teaches us of the part played by insignificant insects, gnats, mosquitos, fleas, bugs and biting-flies, and the still more obscure arachnids, ticks, in conveying the pathogenic organisms through the skin of man. No more valuable advice can be given to those exposed to diseases borne by these insects and by ticks than to keep a "whole skin." May not the entozoa in our digestive organs be playing a part similar to these biting and piercing ectozoa? We cannot keep off tape-worms with mosquito-netting, nor can we destroy threadworms' larvae with films of paraffin oil, but we can by the use of suitable medicaments drive

[1] "Studies from the Zoological Laboratory." The University of Nebraska, No. 69, 1907.

these entozoa out of the body, and by care in selecting and cooking both our food and water materially hinder the access of their larvae to the interior.

Entozoa are indeed much more deadly than the biting Arthropods, because whereas the biting-insect is by no means always infected, and when he (one ought in most cases to say she) is, the protozoa cause them at least as much illness as they cause man, the entozoa are at all times surrounded in the intestine by a constant supply of *B. coli*, and other germs capable of exerting a pathogenic action if they gain access to the deeper tissues.

Since the time when vermifuges practically ceased to be given appendicitis has become more and more common, and is now one of the most dreaded of human diseases in civilised countries. No satisfactory explanation of this has been as yet given. Bagshot somewhat cynically says: "It is a solemn fact that the discovery of a new disease immediately creates a demand for it," but appendicitis is too serious a matter for joking. Even when the appendix is removed and the patient recovered, do we know what we have removed? Because physiologists tell us they are unable to discover any function which the appendix performs it by no means follows that it has no functions. Some years ago they said much the same about the pineal gland, the suprarenal bodies and the pituitary body, but owing to recent research, "nous avons changé tout cela," as Sganarelle said about the position of the heart. I do not myself believe in an organ without some function, be it ever so insignificant. And I have never quite understood why the appendix veriformis should be regarded as a vanishing organ; we know too little about the ancestors of man to assert that this is so. If we go back sufficiently far to some "probably arboreal," vegetable-feeding ancestor, it may be true, but in that case the time which has elapsed would—unless it had acquired a new function—have induced it to disappear altogether like the tail or the general condition of hairiness. No, in my opinion, the theory of "Functionswechsel" is here at work, and there is a function for the appendix, and to quote Bagshot again, "it will now probably be discovered by the 'method of difference.'"

In reference to this matter I may quote from one of the last papers by Professor R. J. A. Berry and Mr. L. A. H. Lack, who have written so much on the appendix:—

"Lastly, in framing our conclusions, it must be borne in mind that such conclusions are not based solely on the appendix of man, but on what has already been worked out by one of us for the animal kingdom in conjunction with what we now find in the appendix

vermiformis of man. The conclusions which we draw from these investigations are as follows:—

"1. Lymphoid tissue is the characteristic feature of the true caecal apex throughout the animal kingdom, including man. As the vertebrate scale is ascended, this tissue tends to be collected together into a specially differentiated portion of the intestinal canal —the vermiform appendix."

"2. The amount of lymphoid tissue present at the caecal apex varies, most probably, though not certainly, in accordance with the varying diet of the animal."

"3. The vermiform appendix of man is not therefore either a vestigial remnant, or an organ in a state of retrogression, but is an actively functional lymph gland. It is no argument against this view to state that because the appendix is frequently removed without any apparent functional disturbance that it is useless, because the same argument might be adduced against the stomach, which is occasionally removed either wholly or in part, and with more or less success."

"4. The appendix of man is not equally functional throughout the whole of life. At birth it contains practically no lymphoid tissue; within six weeks it has become a lymph gland, and continues as such during the first half of life, after which it progressively declines in functional activity. Lymphoid tissue is therefore a tissue of the growing animal."

"5. Obliteration of the vermiform appendix is a pathological process."

"6. The functions of the human appendix are the same as those of any other collection of lymphoid tissue in any other part of the body."

Somewhat similar opinions are held by Professor Blanchard, and I am told that those intrepid extirpators, the surgeons of the United States, are beginning to consider that the removal of the appendix in children retards the growth of the patient.

I am not very sanguine that this address will have any effect. Doctors are most properly a conservative class; Englishmen, as Matthew Arnold pointed out, are somewhat impervious to new ideas. I cannot write with any more authority on medical subjects than that of a "registered medical student," but if it will in even a few cases lead to further enquiry it will repay me a hundredfold for the trouble —and pleasure—I had in writing it.

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[1] Prof. Richard J. A. Berry and Mr. L. A. H. Lack, Journal of Anatomy and Physiology Vol. XL, p. 256.

NOTE ON THE BIOLOGY OF *PESTALOZZIA HARTIGII*, TUBEUF.

By

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WITH PLATE VII.

HISTORY AND PRESENT KNOWLEDGE.

Pestalozzia hartigii is a fungus falling in the *Phragmosporae* section of the *Melanconieae*, a group of the Fungi Imperfecti, or Higher fungi, of which the conidial form alone is known.

It is recognised as the active agent of a seedling disease (*Einschnürungskrankheit*) of several timber trees in Europe. The evidence of its connection with the disease, however, is based entirely on the observation that it is always present when the constriction characteristic of the malady appears.

Before the relation between the parasite and the disease was established by von Tubeuf in 1888 (2), the cause of the latter was variously ascribed to frost, drought and similar agencies. Hartig, for instance, believed it to be due to compression by the mechanical action of freezing soil (1).

Both natural and nursery seedlings, one to five years old, of beech, ash, maple (3), spruce and silver fir (2), have been reported to be subject to attack.

The constriction invariably appears on the stem just above the level of the soil, and is due to the death of the cambium all round, whereas the tissues immediately above, and to a certain extent below as well, continue to grow till the death of the whole plant.

No connection between any species of *Pestalozzia* and any of the definite groups of the Higher fungi has yet been demonstrated, so that the genus still awaits final classification.

LIFE-HISTORY.

Methods.—The original cultures were started with conidia from spruce seedlings that had died of the disease, and which had been sent to Professor C. von Tubeuf from one of the Bavarian Forest Divisions.

[JOURN. ECON. BIOL., September, 1909, vol. iv, No. 3]

The cultures were first started on a jelly of meat and malt extract in Petri-dishes, and were subsequently inoculated on bread moistened with sterilised water.

The work was begun at Professor von Tubeuf's laboratory at Munich and continued at the Royal College of Science, South Kensington. Two cultures, one on bread and one on beech twigs, were brought over from Germany in Erlenmeyer flasks.

For observation of germination in hanging drops, water, prune juice and jellies of beer-wort and of meat and malt extract were employed.

In Petri-dishes a jelly of meat and malt extract formed the nutritive substance, and the more permanent cultures in flasks were on bread and on beech twigs.

Growth of Mycelium and Fructification.

In nature, on living plants, as a rule, no external mycelium is to be seen; the signs of its presence are confined to small black pustules, full of spores, on the surface of the bark at the stricture.

These spores, or rather conidia, are four-celled, with the cells in one row. The two central cells are dark brown and opaque, the end ones hyaline. The apex is provided with two to five long hyaline cilia (Pl. vii, figs. 1, 6, 8). There is a hyaline stalk of variable length. The hyaline parts collapse readily and the cilia are easily broken off, so that when mature the conidia often appear two-celled only, both cells being dark and opaque, with a small hyaline papilla at each extremity. In this condition the conidium is barrel-shaped, and was so described in the earlier text books.

In any of the nutritive media detailed above, the conidia germinated abundantly in less than eighteen hours. Normally, only one of the dark cells puts out a germ tube, but occasionally both germinate (Pl. vii, fig. 7). The germinating cell swells out to assume a spherical shape, and puts out a small process (Pl. vii, figs. 1, 7), which rapidly grows out as a colourless germ tube full of oil drops (Pl. vii, figs. 2, 3, 4, 6).

The germ tube soon forks and branches (figs. 5, 7, 10) to form an elaborate system of hyphae. On bread the mycelium extends over the surface as a white felting and penetrates throughout the substratum. On twigs the mycelium not only covered the surface, but spread out between the twigs in a sheet, binding them together and to the sides of the containing flask.

In all the cultures conidia identical with those already described were formed sooner or later. The earliest reproduction of conidia

occurred in fourteen days, but in some cases fructification was delayed up to forty days.

The conidia arise in pseudo-pycnidia, which are recognisable as small black dots scattered irregularly over the surface of the culture. From these exude large drops of an apparently black liquid, which, under the microscope, can be seen to contain dense masses of the conidia. These conidia were found to germinate as readily as those which yielded the parent cultures.

In some cases a very short germ tube was produced and a new conidium appeared very close to the original one (Pl. vii, fig. 8), but, generally, it was only after a considerable development of the hyphae that fructification set in.

In hanging drops the conidia sometimes grew out singly and remained solitary, but more often they were formed on a side branch, and a number of others would eventually appear on the same or adjacent hyphae to form clusters (Pl. vii, figs. 9, 10, 11, 12). In the hanging drops no approach to a pycnidium was constructed, but, no doubt, in the large cultures the clusters are sunk in the mycelium giving the semblance of pycnidia.

In one hanging drop culture a peculiar growth presented itself. The hyphae were more abundantly septate than usual, and apparently successive conidia were put forth. (Pl. vii, fig. 13).

At first the young conidia are undivided, eciliate and colourless, and later begin to darken and become opaque (Pl. vii, fig. 10). Presently a single median septum is formed, and at that stage the conidium is two-celled and brown. It is only after a further stage of development that the hyaline end cells and the cilia are produced. (Pl. vii, fig. 9).

No other reproductive organs of any kind were observed in any of the cultures.

Inoculation Experiments.

In order to ascertain the manner in which plants are infected in nature the following experiments were carried out:—

Seedlings, one to five years old, of the species detailed below, were planted in pots: Beech, hornbeam, ash, maple, oak, silver fir, spruce, Scotch pine, Weymouth pine, and larch.

Inoculations were made in the following ways:—

Conidia from the pure culture to be employed were first tested and found to germinate freely. They were then extracted in quantities from the culture, and immersed in a spraying-flask in sterilised water. After thorough mixing, a drop of the fluid was

placed under a 1-6in. objective, with a No. 2 eye-piece, and an average of twenty conidia were counted in the field of view.

1. An incision was made with a sterilised blade on the stem of the plants to be inoculated just above the soil, and two drops of the liquid were allowed to fall on the wound, which was then occluded with grafting wax.

2. A similar treatment was carried out on roots below the soil level. The wound was occluded and the soil replaced.

3. The whole of the plant above ground was sprayed with the water containing conidia in suspension, no intentional wound to the plant being inflicted.

4. A small wound was made on the roots, and the soil was watered with the conidia carrying water.

5. The soil was similarly watered, but without damaging the roots.

6. A cut was made on the stem close to the soil level, and conidia were conveyed to the wound direct from a pure culture. The wound was bound up with strips of bast sterilised in alcohol, the spirit being allowed to evaporate off first.

7. A twig was broken off and the exposed surface was smeared with conidia taken direct from a pure culture. The area so treated was bound up with sterilised bast.

8. Finally, sections from a beech twig in the pure culture already referred to were grafted on stems and twigs.

In all cases control plants were set aside for comparison.

Altogether fifty-six plants were inoculated on four occasions: On the 18th December, 1908; 8th January, 5th February, and 8th May, 1909.

In no case did infection result from the inoculation.

Discussion of Results.

It seems that conditions of the nature of which we have at present no knowledge must co-exist in order that infection may take place.

The first two experiments, those of the 18th December and 6th January, were effected on plants that had just been procured and potted, so that they were, in all probability, in a condition of lowered vitality and, therefore, should have been specially susceptible.

It is possible that the co-operation of other organisms is necessary to enable *P. hartigii* to actively attack its host plants. On examining the diseased spruce plants sent into the laboratory at

Munich, I found that several other fungi, including a Penicillium and a yeast, and Bacteria were also present.

It is possible, also, that the first three experiments were made at an unfavourable time of year, and it is desirable that further attempts be made during the summer months. Unfortunately, I am not in a position to continue the research.

The disease is of considerable importance, as serious losses are occasioned in nurseries. The death of up to 30 per cent. of the seedlings has been reported from some Forest Divisions in Germany through the agency of this pest. In the present state of our knowledge, however, no protective steps can be suggested beyond the maintenance of the best cultural conditions in the nursery, so as to ensure strong healthy plants.

The only remedy that can be recommended in the absence of fuller information is the prompt removal and burning of all infected plants.

Summary.

I. The conidia of *Pestalozzia hartigii* germinate readily in water, prune juice, and a jelly of meat and malt extract, within eighteen hours.

II. The fungus can be grown on bread and on sterilised beech twigs.

III. Conidia were reproduced in these cultures in from fourteen to forty days.

IV. No other form of reproductive organs were obtained during eight months culture.

V. All attempts at artificial infection of living plants failed.

My best thanks are due to Professor C. von. Tubeuf for suggesting the investigation, and to Dr. E. Münch for valuable advice during the initial stages of the research.

LITERATURE.

1. **R. Hartig.**—"Allgem. Forst-und Jagd-Zeitung," 1883.
2. **C. von. Tubeuf.**—"Beitraege zur Kenntniss der Baumkrankheiten," 1888, p. 40.
3. **C. von. Tubeuf.**—"Pflanzenkrankheiten," 1895, p. 510.

Also an article by the last named author in the "Forstl. Naturwissenschaftliche Zeitschrift," November, 1892, p. 436.

R.S. del. Huth, Sc. et imp.

PESTALOZZIA HARTIGII, Tubeuf.

EXPLANATION OF THE PLATE VII.

Illustrating Mr. Cecil E. C. Fischer's paper "On the Biology of *Pestalozzia hartigii*, Tubeuf.

All the figures were drawn with the help of the camera lucida.

Fig. 1.—Germinating conidium. × about 475.

Fig. 2.—Conidium with germ tube. × about 475.

Figs. 3, 4, 5, 6, 7.—Conidia with germ tubes. × about 250.

Fig. 8.—Short germ tube with new conidium formed near its parent conidium. × about 250.

Figs. 9, 10, 11, 12.—Progressive growth of conidia in clusters. × about 250.

Fig. 13.—Multi-septate hyphae producing successive conidia. × about 325.

Imperial College of Science,
South Kensington.
June, 1909.

THE BREEDING OF THE COMMON HOUSE FLY (*MUSCA DOMESTICA*) DURING THE WINTER MONTHS.[1]

BY

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THIS short paper is merely an account of a few experiments which I was enabled to carry out at Cambridge at the commencement of this year on the breeding of the Common House Fly under artificial conditions :—

The remarks which it contains are for the most part a repetition of those which appeared in my report to the Local Government Board on this subject.[2]

The chief interest of the experiments is that they determine the duration of the various developmental stages of this insect under definitely controlled conditions of environment as regards food material and temperature, and that under favourable circumstances flies not only remain active, but actually continue to breed during the winter.

The problem as to how and where the common house fly spends the winter months is one which has not at any time ceased to puzzle entomological observers; for while it is well known that the fly disappears at the advent of the first frosts in late autumn, where it goes to and how it survives the winter in order to propagate the species in the following year, still remains more or less a mystery.

At the time when the cold weather commences, those flies which have not sought some protection against the severity of the weather are probably killed at once. Those, however, which have been more fortunate in securing the shelter of some place where the temperature is more suitable, such as a kitchen, restaurant, or bakehouse, continue to live an active life, and as will be seen later, actually continue to breed, providing that the conditions are favourable.

It is possible that some flies exist in a dormant state behind pictures and loose wall paper. Isolated specimens have been

[1] Read before the Association of Economic Biologists, Oxford Meeting, July 13th, 1909.

[2] Reports to the Local Government Board on Public Health and Medical Subjects. New Series. No. 5. 1909.

[JOURN. ECON. BIOL., September, 1909, vol. iv, No. 3.]

observed in a sluggish condition behind books in a bookshelf in December and January. These individuals were kept under observation, and a month later were still in the same positions and still alive.

Unhappily there was no further opportunity of keeping them under notice, but if they could exist through the winter to as late as the end of January in such places, there seems no reason why they should not live on until the spring and then continue to breed. The flies which one sees about at the close of the year are certainly more hardy and more tenacious of life than are those occurring in summer. This was a very noticeable feature in the experiments conducted at Cambridge in the Summer and Winter of last year.

A friend of mine states that upon the removal of an old window frame from his house during the winter, flies, which he believed to be specimens of *Musca domestica,* issued forth from the empty frame in very large numbers, but unfortunately there was no opportunity of examining these flies, and it is quite uncertain whether they were *Musca domestica.* This point is none the less interesting, however, as it indicates the type of winter quarters chosen by some flies which inhabit houses.

It has been suggested, I know not upon what authority, that flies may spend the winter in some one of the developmental stages, probably the pupa. The experiments conducted last winter at Cambridge do not confirm this view, as out of two hundred pupae raised from the eggs and kept at room temperature, not more than nine flies ever emerged, and they died almost at once.

Last February I accidentally discovered a large colony of flies in the sculleries and kitchens of one of the Colleges at Cambridge.

The flies were quite as active as in summer. The kitchens are underground, and the fires are kept up night and day throughout the winter. The temperature varied from 65° F. in the mornings to 80° in the evenings, and the flies though somewhat sluggish in the mornings became more active when the fires were stoked up.

It was decided to experiment with these flies to ascertain whether or not they would breed during the winter under favourable conditions. With this end in view about two hundred flies were captured and transferred to the Quick Laboratory.

By the kindness of Professor Nuttall, the use of a small greenhouse was secured, where a temperature corresponding to that of the kitchens was maintained, and it was in this greenhouse that the experiments were carried out.

Upon Dr. Nash's suggestion it was decided to adopt a method which he had found successful in his fly raising experiments. This

consisted in the detention of the flies in closed vessels with a food supply of moist bread, in which the process of fermentation had commenced. It was found on several occasions that the flies would not oviposit upon bread in which fermentation had not commenced.

For the experiments, ordinary lamp chimneys were used. These were all covered at one end with a piece of fine muslin, which was secured in its place by means of thread and melted paraffin wax. The flies—about a dozen of both sexes—were introduced into each chimney. The free ends of the chimneys were then packed with "bread-mash" and small pieces of newspaper, and inverted in a large tray of moist sand. The sand was moistened from time to time and so supplied the bread with moisture as and when required. In order to assist fermentation a small glass plate was placed on the ends of the chimneys to curtail the supply of air, but each day it was removed for a short while to allow of the admission of air to the flies.

After the flies had been confined for twenty-four hours they were observed to be ovipositing, and on the following day all the eggs had hatched.

The bread had by this time become very mouldy. It was noticed that the larvae displayed great dislike for the mould, as they took up positions as remote as possible from it, crawling up the sides of the chimneys to the places where air was being admitted.

The larvae were then transferred to a large glass tank, and over them was placed a thick slice of bread cut near the outer crust, and having the crust uppermost. The bread, which was stale, was slightly moistened, and the larvae then proceeded to feed. Over the top of the tank was stretched a piece of fine muslin, which was secured in its place by an elastic band, and over this was laid a plate of glass, leaving just a small space to allow of the admission of air. Scattered around the bread were several pieces of newspaper, under which the larvae eventually pupated. Where this method was employed, it was found that the larvae rarely left their feeding ground until they were fully fed, when they left the moist mass of bread for the surrounding dry area, and there pupated beneath the pieces of newspaper.

At a temperature ranging between 65° F. to 75° F. the complete development from the time of oviposition took three weeks.

The times for the various developmental stages were as follows:—

The Egg.—As soon as fermentation had commenced, the female flies began to oviposit, having previously selected as a suitable spot for oviposition, some place underneath the mass of bread. The

eggs, which were 0.5 mm. in length, and 0.15 mm. in breadth, were deposited in bundles of about fifty.

In twenty-four hours all the eggs had hatched.

The Larva.—The young larvae began to feed soon after emerging from the eggs, and commenced to grow rapidly, and after a period of thirty-six hours underwent their first moult. Having cast their skins the larvae continued to grow, and after four days the second ecdysis or moulting took place.

The larvae in the third instar, the last larval stage, grew very rapidly, and after a further period of five and a half days, left the food mass for the drier surrounding area and commenced pupation. This process lasted about six hours on an average. It commenced by a shrinking of the skin, and a gradual change in colour from a creamy white to a light brown. Later this light brown colour gave place to a darker brown. The whole larval period occupied eleven days.

The Pupa.—The time which elapsed before the emergence of the adult fly varied considerably. At 70° F. the longest period was eighteen days, but the average period was ten days. A few pupae placed in an incubator at 77° F. gave rise to the flies as early as the third day.

Several pupae placed in the kitchens where the flies were originally captured, did not give rise to the flies for eleven days. As above stated, the temperature of these kitchens corresponded approximately with that of the greenhouse where the experiments were carried out.

About two hundred pupae were kept at the room temperature of the Laboratory, but of this number only nine flies ever emerged, nearly four weeks elapsing before they did so, and they all died shortly afterwards. It appears from these figures that the pupae will not give rise to adults unless the temperature is favourable.

If such is the case it is improbable that flies spend the winter in the pupal stage as has been suggested.

The Adult.—Upon the emergence of the adults, they were all transferred to a large net cage, with the object of determining the length of life of the flies. They were successfully kept alive for eleven and a half weeks. The original flies caught in the kitchens were kept in captivity for ten weeks. How long they had lived before they were captured is of course unknown.

In the summer of last year in no case were the flies kept alive for more than three weeks, and then only in the case of a few individuals.

It appears therefore that the flies occurring at winter time are either more hardy or else more long-lived than the summer broods.

During the Easter vacation of this year the kitchen fires were allowed to go out for three weeks, causing a considerable fall of temperature. Upon visiting the kitchens at the end of this period, not a single fly was to be seen. It was five weeks before a fly was again seen there, and up to the time of writing (June, 1909), there have not at any time been more than about a dozen flies.

Conclusions.

The following conclusions are taken from my report to the Local Government Board, and are based upon the foregoing experiments:—

1. Flies do not disappear altogether during the winter as popularly thought, but may be found in places where the temperature conditions, etc., are favourable.

Whether under such circumstances they ordinarily continue to breed as in the warmer months cannot be said, but that they *will* breed in the winter, provided that the necessary conditions are present, is evident from the foregoing experiments.

2. The fact that the flies have been seen in coitû in great numbers, seems to favour the view that they may breed in these warm places in the winter, assuming that their breeding places remained undisturbed during the larval stage.

3. On the other hand, the fact that flies taken at this time of the year appear more hardy and long lived, than those taken and kept under the same conditions in the summer, seems to support the view that the former may persist throughout the winter as adults.

4. If, as seems probable, flies are only to be found in winter in isolated colonies in certain warm places, the possibility of an appreciable reduction in their numbers, or even perhaps of their extermination, may become somewhat more hopeful. In such places they could easily be destroyed, as even the slightest exposure during the cold months is fatal to them. This is seen to advantage in the above case, where the fall in temperature, occasioned by the putting out of the fires for the Easter vacation caused the complete disappearance of the flies for a period of five weeks.

THE RÔLE OF COLLEMBOLA IN ECONOMIC ENTOMOLOGY.[1]

BY

WALTER E. COLLINGE, M.Sc., F.L.S., F.E.S.

WITH 1 FIGURE.

AMONGST the many points of interest presented to the zoologist by the Order Collembola, not the least is that of their economic importance.

It is only within comparatively recent years that they have been regarded as injurious insects, and even now they are generally held to be not the primary cause of injury.

In 1905 Professor Carpenter[2] called the attention of economic biologists to this Order, and instanced cases of direct damage to the roots and seeds of healthy plants, since that date large quantities of materials have passed through my hands and numerous experiments have been made, with the result that one is forced to the conclusion that these tiny insects are not unfrequently the primary and only cause of injury to certain plants, and that they also play an important part in exposing different plants to the attacks of fungi by the injury they cause in wounding their surface.

The number of British species has been estimated by Carpenter and Evans[3] at about 75, but more recent investigations have raised this number to over one hundred, and there are probably many others awaiting discovery.

The references in the literature are comparatively few. Curtis[4] mentions a species of *Sminthurus* as feeding upon the parenchyma of the green leaves of the potato, and states: "In Novia Scotia the crops of turnips and cabbages are principally destroyed, whilst in the seed leaf, by some *Sminthurus,* the size of a pin's head, and nearly globular. It hops with great facility by means of its forked tail, and may be found on every square inch of all cultivated land, but it is not plentiful on new land." He also alludes to a *Podura*

[1] Read before the Association of Economic Biologists, Oxford Meeting, July 13th, 1909.

[2] Proc. Assoc. Econ. Biol., 1905, vol. i, p. 14.

[3] Proc. Roy. Phys. Soc. Edinb., 1899, vol. xiv, p. 224.

[4] Farm Insects, p. 432.

(*P. plumbea*, Linn.) being abundant in February, 1846, skipping about the rotting potatoes.

Murray[1] speaks of young gherkins being "stripped of great portions of their skin, that have been browsed or rasped away by these little creatures." He also refers to the damage they do to succulent roots and plants, especially where anything has happened to diminish the vitality of the plant.

Miss Ormerod[2] records injury to the leaves of turnips by *Sminthurus luteus*.

Guthrie[3] states that he learned from Professor H. E. Summers, State Entomologist of Iowa, that a species, probably belonging to the genus *Achorutes*, was so abundant in the soil containing seeds, and kept it so thoroughly worked up, as to give the little plants no chance to root, and that many died.

A very similar case has come under my own notice, when a large bed of sweet peas was completely destroyed by *Achorutes armatus* (Nic.). As soon as ever the seeds commenced to root the soil was moved by the movements of these tiny insects, and ultimately, when about three inches high, the plants fell over and died.

Carpenter[4] has also recorded this species, *A. longispinus*, Tullb., and *Lipura ambulans*, Linn., damaging bean seeds. This latter species frequently causes extensive damage to bulbs. I have recorded a case from nursery gardens, Birmingham, where Narcissus bulbs were attacked by this species, and *Achorutes armatus*.[5] A further case has recently been brought to my notice where a large house of bulbs were rendered completely unfit for sale owing to an attack of *L. ambulans*. This same species is frequently found attacking the roots of cruciferous plants.

Mr. Theobald[6] records a species of *Orchesella* and other Collembola attacking orchids; also *Entomobrya nivalis*, Linn.,[7] as causing considerable damage to hops. The attack was noticed about the middle of July, when the burr was being rapidly cleared off and the bine was also damaged where tender. The damage seemed to be mostly done at night, the insects sheltering under clods of earth during the day time.

Still a further case is recorded by the same writer, viz., a species

[1] Economic Entomology, Aptera, p. 404.

[2] Rpt. Obs. Inj. Insects for 1904, p. 110.

[3] The Collembola of Minnesota, 1903, p. 4.

[4] Proc. Assoc. Econ. Biol., 1905, vol. i, p. 14.

[5] Rpt. on Inj. Insects for 1905, p. 10.

[6] First and Second Rpt. Econ. Zool., 1903, p. 110, 1904, p. 75.

[7] Rpt. Econ. Zool. for 1908, p. 100.

of *Isotoma* as being a great torment to fowls, being found in old and foul nests.[1]

Marlatt[2] has recorded a species of *Lepidocyrtus* as infesting houses in the United States.

During the past twelve months very careful observations have been made upon a series of common species which have fully established the fact that to orchids, numerous bulbs, beans, and peas, the Collembola are distinctly injurious.

The method adopted has been as follows:—

Shallow boxes, containing about four inches of moist soil, have been used, and into these perfectly healthy bulbs and beans have

Fig. 1.—Piece of Stem of Zinnia, showing damage due to Springtails.

been placed. Into each box examples of different species of Collembola have been placed. The tops of the boxes in some cases were covered with a sheet of glass, and in others with a piece of wood.

After the experiments were completed the soil and diseased bulbs were carefully examined, and apart from fungi no other pests were found, but in all cases the Collembola had increased largely in numbers.

[1] Paras. Dis. Poultry, 1896, p. 37.

[2] Canad. Entom., 1896, vol. 28.

The specimen of Zinnia shown in Fig. 1 will well illustrate the serious nature of the damage these insects sometimes do.

Amongst the bulbs the Hyacinth, Narcissus, and Tulip have perhaps been the worst sufferers. The nature of the injury is practically the same in all cases, and consists in scraping away the epidermis and then the softer tissue until a distinct hole or depression is formed. After this stage, decomposition of the plant tissues rapidly takes place, due to the inroads of fungi, and the bulb is practically ruined.

A list of the species which are distinctly injurious is appended herewith, but in all probability all Collembola are more or less injurious to plant life. I should be very pleased to receive particulars of, or plants damaged by other species.

*__Lipura armata,__ Tullb.
Lipura ambulans (Linn.) Tullb.
Lipura burmeisteri, Lubb.
Lipura fimetaria (Nic.) Lubb.
Achorutes armatus (Nic.)
Achorutes manubrialis (Tullb.)
Anurida granaria (Nic.)
Isotoma palustris (Müll.)
Orchesella cincta (Linn.)
Entombrya nivalis (Linn.)
Entomobrya multifasciata (Tullb.)
Lepidocyrtus
Sminthurus fuscus (Linn.)

* I use the generic term *Lipura* as that of *Onychiurus*, Gerv., might be misleading in a paper of this kind.

NOTES ON SOME COLLEMBOLA NEW TO GREAT BRITAIN.

By

WALTER E. COLLINGE, M.Sc., F.L.S., F.E.S.,

AND

JOHN W. SHOEBOTHAM, N.D.A.

For some time past we have been investigating the Collembolan fauna of the County of Hertfordshire, with the result that we have a very formidable list before us of these minute but deeply interesting insects.

Our work is yet far from complete, but we think certain of the species we have obtained are of sufficient interest to warrant their being placed on record.

All the species here recorded have been found in Hertfordshire, in fact all have been taken within one mile of Berkhamsted. It is interesting to observe that in several of the new species recorded there are less than the normal number of eyes.

Family **PODURIDAE**, Lubb., C.B.

Genus **Pseudachorutes**, Tullb.

It gives us great pleasure to be able to record this genus for Great Britain. The general shape of the body is that of a somewhat short *Achorutes*. Mouth, suctorial. Antennae, conical. Eyes 16, eight on each side of the head. Anal horns and lower claw (empodialanhang) absent.

The species of this genus seem to prefer to live under the bark of moist rotting wood. This is what we would expect when we consider the suctorial mouth.

We have two species, but one we have not identified with any described form yet.

Pseudachorutes subcrassus, Tullb.

Tullberg, Förteckning öfver Svenska Podurider, 1871, p. 155.

This is the type species on which the genus was founded. The post-antennal organ has 10 tubercles arranged in a ring. Tibia without tenent hair. Colour, light greyish blue, lighter underneath.

Hab.—Near Berkhamsted, Herts., under bark of rotting wood.

Genus **Achorutes**, Templ.

Achorutes neglectus, Börner.

Börner, Apterygoten-Fauna von Bremen und der Nachbardistrikte, 1901, p. 30.

This species has short and scanty hairs on the body, rather more on abdomen V. and VI. Upper claw with one inner tooth, lower claw bristle-like in this respect resembling *A. manubrialis,* Tullb. Tibia with one tenent hair. Anal horns absent. Dens twice as long as the mucro. Colour, dark grey-blue, pigment mottled, underside lighter.

Hab.—Berkhamsted, Herts., amongst short grass, and on a puddle of water, evidently washed by rain from the above.

Family **ENTOMOBRYIDAE**, D.T.

Genus **Isotoma**, Bourl.

Isotoma binoculata, Wahlgr.

This species seems to be intermediate between the blind *I. fimetaria* (Linn.), Tullb., and the species *I. quadrioculata,* Tullb.

The single eye on each side of the head is in the position of the anterior one of *I. quadrioculata,* Tullb. It is whitish in colour, with a little greyish pigment, except for the eyes, which are black. We have only one specimen.

Hab.—Berkhamsted, Herts., under a flower pot in a greenhouse.

Isotoma minor, Schäff.

Schäffer, Collembola der Umgebung von Hamburg und benachbarter Gebiete, 1896, p. 182.

We have found a few specimens of this species in several situations around Berkhamsted, such as under sticks in a wood, under flower pots in a greenhouse, and one specimen we found under a stone along with *Neelus murinus,* Folsom.

It may be distinguished from *I. fimetaria* (Linn.), Tullb., which it at first sight somewhat resembles, by the presence of feathery setae on the abdominal segments, and six or seven peculiar sensory hairs (smelling hairs? of Börner) on the fourth antennal segment. It has three teeth on the rather short mucro instead of two on the more elongated one of *I. fimetaria.* Moreover, *I. fimetaria* has a post-antennal organ which is absent in *I. minor.*

The claws are without teeth. Colour very light grey, in alcohol white.

Hab.—Berkhamsted, Herts.

Genus **Sinella,** Brook.

Sinella höfti, Schäff.

Schäffer, Collembola der Umgebung von Hamburg und benachbarter Gebiete, 1896, p. 192.

This white, blind species we have found running about very actively inside flower pots in a greenhouse, along with *S. curviseta,* Brook, from which it may be distinguished by the absence of eyes, and the mucrones having only one tooth. Dr. Börner figures a tenent hair in his drawing of the foot, but in all the specimens we have examined we cannot find that the hair is thickened at the end. It is significant that Schäffer describes as one of the characters of the genus, the absence of a tenent hair on the tibia.

The lower claw has a broad lamella on its outer side, reaching half its length, reminding one of the lower claw of *Cyphoderus albinos,* Nic.

Hab.—Berkhamsted, Herts., in greenhouse and under stones in the Castle Grounds.

Genus **Lepidocyrtus,** Bourl.

Lepidocyrtus sexoculatus, Guthrie.

Guthrie, The Collembola of Minnesota, 1903, p. 186.

We have one specimen which we believe came from under sticks in the Castle Grounds, Berkhamsted. It may be known from all other British species of *Lepidocyrtus* by the presence of two black eyespots on each side, the anterior one having two ocelli and the posterior one a single ocellus. We are not aware of its having been found in Europe before.

Hab.—Berkhamsted, Herts.

Genus **Pseudosinella,** Schäffer.

Pseudosinella alba (Pack.), Schäff.

Schäffer, Ueber württembergische Collembola, 1900, p. 269.

Lepidocyrtus albus, Packard, 1873.

Tullbergia ocellata, Lie-Pettersen, 1896.

Pettersenia ocellata, (Lie-Pettersen), 1898.

Like *Sinella curviseta,* Brook, it has two eyes on each side of the head, but the arrangements are different. In *S. curviseta* the two eyes are behind one another on two separate spots, whilst in *P. alba,* the two eyes are close together in one dark spot and arranged transversely.

There is a non-clavate hair in the place of a tenent hair.

Hab.—Berkhamsted, Herts., under sticks lying on the ground, in loose soil, and amongst decaying leaves.

BIBLIOGRAPHY.

Börner, C.—Zur Kenntnis der Apterygoten-Fauna von Bremen und der Nachbardistrikte. Beitrag zu einer Apterygoten-Fauna Mitteleuropas Abh. Naturwiss. Ver. Bremen, 1901, Bd. xvii, Heft 1.

Guthrie, J. E.—The Collembola of Minnesota. Geol. and Nat. Hist. Surv. of Minnesota. Zool. series IV, 1903.

Lie-Pettersen, O. J.—Norges Collembola. Fortegnelse over de i Norge hidtil observerede arter. Bergens Mus. Aarbog, No. VIII, 1896.

Lie-Pettersen, O. J.—Apterygogenea in Sogn und Nordfjord 1897, u. 98 eingesammelt. Bergens Mus. Aarbog, No. VI, 1898.

Packard, A. S.—Synopsis of the Thysanura of Essex County, Mass., with Descriptions of a few extralimital forms. Fifth Ann. Rpt. Peabody Ac. Sci. 1873.

Schäffer, C.—Die Collembola der Umgebung von Hamburg und benachbarter Gebiete. Mitt. Naturh. Mus. Hamburg, 1896.

Schaffer, C.—Über Württembergische Collembola. Jahresh. Ver. Württemb., 1900, Bd. 56.

Tullberg, T. F.—Forteckning öfver Svenska Podurider. Öfversigt af K. Vetensk. Akad. Förhandl. Stockholm, 1871.

Wahlgren, E.—Ueber die von der Schwedischen Polar expedition, 1898, gesammelten Collembolen. Öfversigt af K. Vetensk Akad. Förhandl., 1899, lvi.

ON THE ANATOMY AND LIFE-HISTORY OF *RHABDITIS BRASSICAE*, N.SP.

By

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With Plate VIII.

In November, 1908, I received through Mr. J. Adams, M.A., of the Royal College of Science, Dublin, a turnip which was in an advanced state of decomposition, and was infested with vast numbers of minute Nematode worms. The turnip was sent from Co. Westmeath. It is with the structure and life-history of this worm that the present paper deals.

These Nematode worms belong to the family *Anguillulidae,* popularly spoken of as "eel-worms." They are extremely common in water, soil, and decaying organic matter. In the case of a few well-investigated species, such as *Heterodera schachtii,* Schmidt, causing "beet-sickness," *Tylenchus tritici,* Need., causing "ear-cockles" in corn, *Tylenchus devastatrix,* Kühn, etc., it has been placed beyond doubt that they are the cause of serious diseases in plants. In the majority of the cases, however, where these worms are found in considerable numbers in diseased plants, it is doubtful whether the eel-worms originate the disease or merely take advantage of a weakened condition of the plant. Such genera as *Tylenchus, Heterodera, Dorylaimus,* etc., are provided with a sharp spine, by means of which the epidermis of the plant can be pierced and its juices sucked. Even in such cases, however, the matter is frequently complicated by the presence of parasitic fungi, which may be responsible for the origin of the disease.[1]

In other genera, such as *Rhabditis, Plectus,* etc., this piercing apparatus is absent, and the power of these worms to originate disease in plants is not so obvious. Once the epidermis of the plant is pierced, the powerful sucking pharynx, with which these worms are provided, enables them to feed on its juices. When they are

[1] Board of Agriculture, Leaflet No. 46. "The Stem Eelworm *(Tylenchus devastatrix, Kühn).*" 1898, page 2.

[Journ. Econ. Biol., September, 1909, vol. iv, No. 3.]

found in large numbers in a plant, the latter is usually in an advanced state of decomposition. Extensive observation and experiment in the field is necessary before one can state definitely whether these worms are a primary cause or only a symptom of disease.

The species I am about to describe is apparently new to science, and I propose to name it

Rhabditis brassicae, n.sp.

The genus *Rhabditis* contains about fifty species. Many of these are very insufficiently described and figured, and in some cases only the female is known. The females do not show such good specific characters as the males, and their identification is very difficult and unsatisfactory.

The members of this genus show great differences in their mode of life, and sexual relations. Some are parasitic in animals, some live in damp earth, or water, and others in decaying substances. They may be hermaphrodite, or of different sexes. In *R. brassicae* both sexes are found in approximately equal numbers. The female is 1-1.15 mm. long, the male .9-1.05 mm. The relative proportions of the oesophagus, tail, width of body, etc., are usually expressed as percentages of the length. In the following table similar measurements are given for a larval form, without genital organs. The width of the female is taken through a specimen with well-developed eggs.

	Male.	Female.	Inimature form.
Total length of body ...	1·05 mm.	1·15 mm.	·71 mm.
Oesophagus ...	·2 = 19%	235 = 20·4%	·165 = 23·2%
Buccal cavity ...	·025 = $\frac{1}{8}$ of oesophagus	—	—
Tail	·075 = 7·1%	·155 = 13·5%	·125 = 17·6%
Width	·05 = 4·76%	·07 = 6·1%	·031 = 4·5%
Vulva of ♀ ...	—	·63 from anterior end, = 55%.	—

The cuticle is smooth and without setae. The mouth is bounded by six low lips, each bearing a very small papilla (Pl. viii, fig. i). The buccal cavity is long and narrow, and at its base the lumen narrows rapidly. The anterior bulb is placed in the middle of the oesophagus, and is very muscular. The posterior bulb is almost spherical, and possesses the usual valvular apparatus. Midway between the bulbs is the nerve cord (Pl. viii, fig. 1, *n*). In the female the tail is long and filiform. There are several caudal glands behind the anus. The vulva is situated just behind the middle of the body.

The ovary extends three-quarters of the way to the anus and four-fifths or more of the way to the oesophagus. Each branch then runs back almost to the level of the vulva, and is then folded back once more (Pl. viii, fig. 3). In the mature female the vulva is somewhat prominent, and the vagina conspicuous. The uterus is large, and each branch may contain as many as fifteen fertilised eggs in various stages of development up to the morula stage. On many occasions I saw larval forms moving about freely within the body of the female, and there is no doubt that all transition stages between oviparity and viviparity are shown, though the latter is rare, and depends on circumstances which I failed to ascertain. I observed larval worms feeding on the internal organs of the female till only the cuticle remained, as described by Maupas[1] (p. 483) for *R. elegans*. I also saw eggs with 12 blastomeres being extruded. The eggs are always more or less segmented before extrusion.

Following the uterus is a chamber containing spermatozoa (Pl. viii, fig. 3, *s.r.*). The latter are developed in the genital gland before the ova mature. This species thus resembles several other members of the genus in that the females function as self-fertilising protandrous hermaphrodites. This phenomenon was first observed by Schneider[2] and thoroughly investigated recently by Maupas (*tom. cit.*) in a very interesting and able paper. In some cases spermatozoa could not be seen, and the cavity—known as the seminal receptacle—was empty. The sperm had probably been used up in fertilising the first eggs. The genital gland, for some distance beyond the seminal receptacle, is occupied with large ova, laden with yolk. The ova gradually decrease in size towards the free end of the genital gland. The ova, as they mature, pass through the seminal receptacle into the uterus, and during this passage, according to Maupas (*tom. cit.*, p. 585) each is fertilised by one of the spermatozoa. When the latter are all used up, the ova that follow are sterile, and do not develop.

In the males, the tail is long and filiform (Figs. 4 and 5). There are several small caudal glands (Fig. 5). Behind the anus, the body is conical, and terminates in a bifid tip (fig. 4 *b*) from between the minute lobes of which the filiform tail originates. The bursa is well developed, and extends some distance along the tail. It is provided with nine pairs of papillae, which are placed at regular intervals, the distances between them diminishing towards the tail. Six of

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[1] E. Maupas "Modes et formes de repreduction des Nématodes." Archiv. Zool. Exp. et gén., 1900, T. 8, p. 463.

[2] A. Schneider. Zeitschrift für wiss. Zool., 1860, T. x. p. 178. Also in *Monographie der Nematoden, 1866, p. 315.*

these papillae are below the anus (fig. 5), one is opposite the posterior end of the accessory pieces, one level with the posterior end of the spicules, and one is opposite the middle of the latter. The testis is very large, and after extending almost to the oesophagus, it curves back for a short distance. The spicules (figs. 4-6) are stout and curved. The proximal end is knob-shaped, whilst the distal end is distinctly bifid, thus resembling *R. duthiersi,* Maupas, to which it has a close general resemblance. The accessory pieces are slender and curved. They are connected at the end farthest from the male pore (fig. 4).

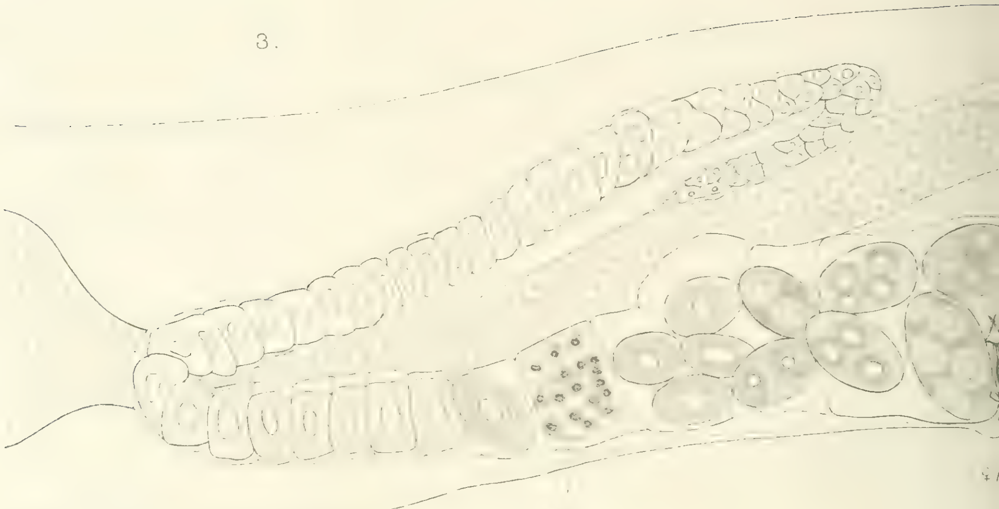
This species bears a very close resemblance anatomically to *R. aspera,* Bütschli,[1] from which species it differs in size, relative proportions, spicules, etc., but chiefly in the structure of the genital organs of the female, *R. aspera* being dioecious. From *R. duthiersi,* Maupas (*tom. cit.,* p. 513), it is distinguished by its smaller size, the shape of the tail in both sexes, greater size of the genital glands, and in the male by the different arrangement of the glands on the bursa, the different shape of the spicules, etc. In the female the uterus is larger and contains more eggs.

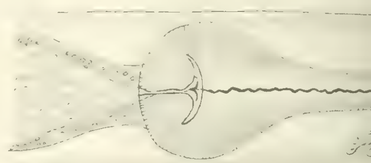
In all the hermaphrodite species of this genus so far described, the males are either unknown, or very rarely met with. Maupas (*Tom. cit.,* p. 588) who investigated this point, states that the proportion of males to females varies from 45 to 1,000 in *R. viguieri,* to .15 to 1,000 in *R. guignardi.* In *R. duthiersi* the proportion is 20 to 1,000. We see here a change from a dioecious to a hermaphrodite mode of reproduction, which in some species is almost complete, and no males are produced. Even in those cases where a small number of males is produced, it seems probable from Maupas' researches that the males have quite lost the sexual instinct, and play little or no part in the sexual process.

In the proportion of males and females, *R. brassicae* differs greatly from all the known protandrous hermaphrodites. The numbers varied greatly in several cultures which I made and counted, but the males are quite as common as the females. In one case there were 15 males to 22 females, in another 44 males to 12 females. I obtained no evidence that the males play any part in the sexual process. It is interesting to note that Maupas (*tom. cit.,* p. 588) ventured to predict the occurrence of a protandrous hermaphrodite in which the numbers of males and females would be fairly equal. In the proportion of the sexes, then, *R. brassicae*

[1] O. Bütschli. Beiträge zur Kenntniss der freilebenden Nematoden. Nova Acta der Ksl. Leop.—Carol deutschen Akad. der Naturf. Bd. xxxvi. Nr. 5. p. 113. 1873.

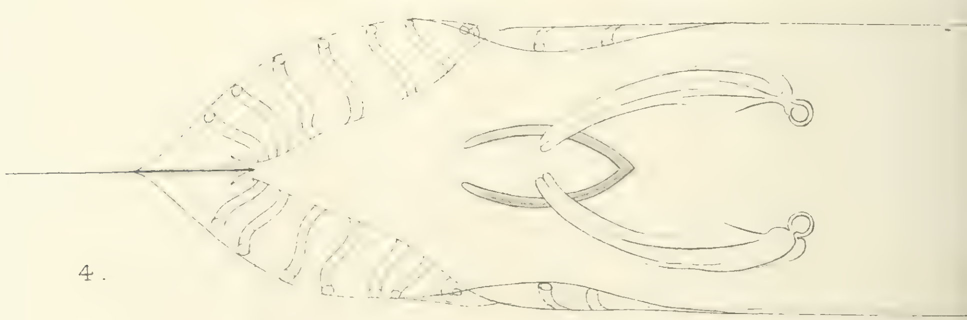
3.





a.

6.



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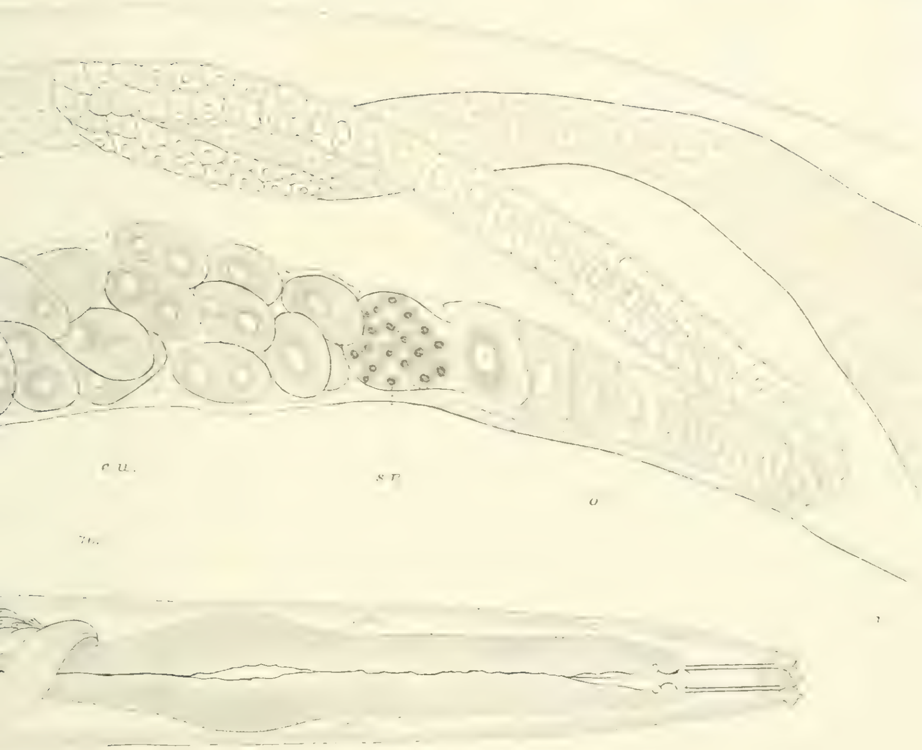
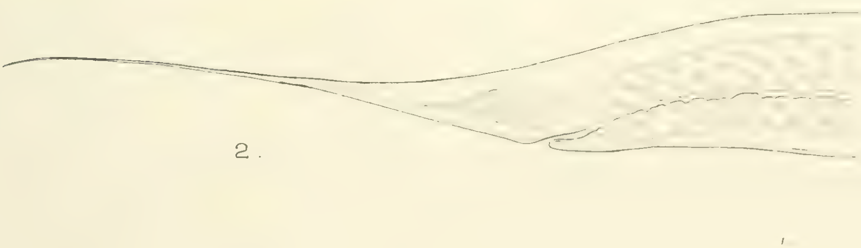
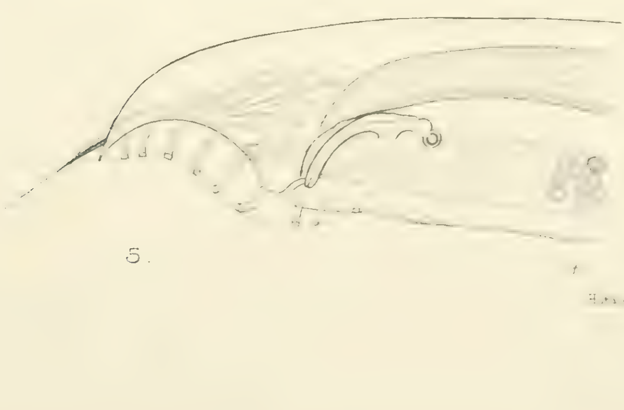


1.



2.



5.

H. . . et imp.

ICAE, n. sp.

closely resembles the dioecious species, and probably represents one of the earliest stages in the transformation from the dioecious to the hermaphrodite condition.

I made some experiments on turnips with these worms, in order to ascertain if possible whether they could originate disease. When placed in contact with a cut surface, they quickly reduced the turnip to a pulp, and finally nothing was left but a little fibre and a large quantity of water. The worms reproduce and increase in numbers with excessive rapidity. Attempts to inoculate a turnip through the uninjured epidermis, however, quite failed. In one case, the worms were repeatedly placed on the surface of the turnip in large numbers, and kept in a damp dark chamber for a month, and at the end of that time the turnip appeared none the worse, and the epidermis was quite sound. The evidence thus goes to show that this species—and probably the others belonging to this genus, which are found in decaying vegetable matter—cannot originate disease, but that if they can gain access to the soft tissues, through injury to the epidermis, they will quickly destroy the plants.

DESCRIPTION OF PLATE VIII.

Illustrating Mr. Rowland Southern's paper "On the Anatomy and Life-history of *Rhabditis brassicae*, n.sp."

All the figures are drawn with the aid of an eye-piece micrometer.

Fig. 1.—Male, anterior end.

Fig. 2.—Female, tail.

Fig. 3.—Female, showing arrangement of hermaphrodite glands. *i.* intestine. *e.u.* eggs in uterus. *o.* ova maturing by addition of yolk. *s.r.* seminal receptacle.

Fig. 4.—Male, posterior end, ventral view. *b.* bifid termination of the trunk.

Fig. 5.—Male, posterior end, side view. *i.* intestine. *t.* vas deferens.

Fig. 6.—Male, spicules. *a.* accessory piece.

NOTE ON THE INFESTATION OF A COCCID BY CHALCID PARASITES.

By

E. ERNEST GREEN,

Government Entomologist, Ceylon.

THE following facts may be worthy of record, as bearing upon the value of the importation of parasites to combat insect pests—a principle that I consider to have been greatly overstrained.

In the course of my study of a collection of *Coccidae* received from the Indian Museum, I had occasion to make a preparation of a single example of *Icerya aegyptiaca*. After boiling the insect in caustic potash, the liquor was found to be full of minute Chalcid wasps (still enclosed in the nymphal membrane) that had escaped from its ruptured body: and many more examples of the same Chalcid were still entangled within the tissues of the Coccid. Before making a count, I had unfortunately changed the liquid, so that many of the minute wasps were lost. But I estimate that there must have been at the very least one hundred parasites bred inside this single Coccid. Yet, in spite of such an army feeding at its expense, the body of the host also contained numerous well-developed embryos, and there were remains of an ovisac that had presumably contained many more ova. It is evident, from these facts, that even such complete infestation as here noted, is insufficient to prevent the productiveness of this particular pest.

Peradeniya, 24th June, 1909.

[JOURN. ECON. BIOL., September, 1909, vol. iv, No. 3]

REVIEWS.

Guénaux, G.—Entomologie et Parasitologie Agricoles. Pp. xii + 528, 413 figs. 2nd ed. Paris: J. B. Baillière et Fils, 1909. Price 5 fr.

We welcome a second edition of M. Guénaux's handy little volume, which is full of valuable information.

It is concisely written, well illustrated, and is one of the best volumes in the Encyclopédie Agricole, of which it forms a part.

Harmer, S. F., and Shipley, A. E.—The Cambridge Natural History. Vol. iv. Pp. xviii + 566, 287 figs. London: Macmillan and Co., Ltd., 1909. Price 17s. net.

The appearance of volume iv completes the ten volumes of this work. The subjects treated of are as follows: Crustacea, by Geoffrey Smith and the late W. F. R. Weldon; Trilobites and Eurypterida, by Henry Woods; introduction to Arachnida and King Crabs; Tardigrada, and Pentastomida, by A. E. Shipley; Scorpions, Spiders, Mites, Ticks, etc., by Cecil Warburton; and Pycnogonida, by D'Arcy W. Thompson.

The names of the authors are a sufficient guarantee of the thoroughness with which all the sections are treated; especial mention, however, must be made of Mr. Shipley's articles on the Tardigrada and Pentastomida.

The chapter on the general organisation of the Crustacea, as also that by the late Prof. Weldon, are excellent, but many of the Orders and sub-Orders in the later chapters are very briefly treated of. We especially note the absence of any reference to Groom's work on the Cirripedia, Canon Norman's on various Orders, and other leading investigators.

Chapters xii—xvii, treating of the Arachnida, supply a want long felt, and Mr. Warburton is to be heartily congratulated upon the remarkably full and valuable account he has given. The twenty pages devoted in chapter xviii to the Mites and Ticks, are most disappointing. The author has neither been able to do justice to himself or his subject.

In conclusion we congratulate the editors on the completion of their task. Certain volumes stand out as of conspicuous merit, and throughout them all, most of the articles are of a high order of merit, and have already proved of great value to students of zoology, whilst the illustrations have not been surpassed in any previously issued work of a similar nature.

W. E. C.

Lankester, Ray.—A Treatise on Zoology, Pt. IX, Vertebrata Ceraniata. (First Fascile: Cyclostomes and Fishes). By E. S. Goodrich. Pp. xvi + 518, 515 figs. London: Adam and Charles Black, 1909. Price 15s. net.

In calling attention to this splendid piece of work we cannot refrain from mentioning the fact that students of fish morphology have at last a text-book leaving little to be desired, and one in which the author is not ashamed to acknowledge the source of his information.

It would be invidious to compare the different volumes of this great work, but we cannot help remarking that this one fully maintains, if not exceeds, the high standard laid down by previous authors.

We welcome at last a rational system of classification, in which the old divisions of Ganoidea and Teleostei have disappeared. We are rather surprised to find an entire absence of any reference to the suprarenal organs of fishes or cyclostomes. All other systems are carefully and thoroughly described and excellently illustrated. It is pleasing to note an absence of many of the old figures which have done duty for so long.

In the useful Bibliography we note that there is no reference to the classical researches of Prof. W. C. M'Intosh, or to the writings of Dr. Gaskell, although the latter is mentioned in the text.

Hitherto we have had no work of recent date on fishes that could be regarded in any sense as authoritative, the original work of the author of this volume, together with that of numerous recent investigations, is now summarised and in a convenient form, and will be highly appreciated by all students of zoology, and must remain for many years to come the standard work on the morphology of fishes.

W. E. C.

CURRENT LITERATURE.

I.—General Subject.

Herms, W. B.—Recent Work in Insect Behaviour and its Economic Significance. Journ. Econ. Entom., 1909, vol. 2, pp. 223-230.

II.—Anatomy, Physiology, and Development.

Bruyant, L.—Larve hexapode de Trombididé parasite des insectes et rapportée à *Trombidium trigonum*, Herm. Zool. Anz., 1909, Bd. xxxiv, pp. 321-324, 5 figs.

Börner, C.—Die Tracheenkieman der Ephemeriden. Zool. Anz., 1909, Bd. xxxiii, pp. 806-823, 4 figs.

Crampton, G. C.—A Contribution to the Comparative Morphologie of the Thoracic Sclerites of Insects. Proc. Acad. Nat. Sci. Philad., 1909, pp. 3-54, plts. i-iii, 21 text figs.

Grove, A. J.—The Anatomy of *Siphonophora rosarum*, Walk. Pt. 1. The Apterous Viviparous Stage. Parasitology, 1909, vol. ii, pp. 1-28, plt. i.

The author gives an interesting account of the general anatomy of this species. He notes the absence of any definite organ comparable to the salivary pump described in other species, and fully discusses the structure and mechanism of the mouth parts.

Janet, Charles.—Sur la Morphologie de l'Insecte. Fasc. 27, pp. 75, 2 figs. Limoges: Ducourtieux et Gout, 1909.

Kepner, W. A.—Nutrition of the Ovum of *Scolia dubia*. Journ. Morph., 1909, vol. xx, pp. 125-141, plts. 1, 2.

Snodgrass, R. E.—The Thoracic Tergum of Insects. Entom. News, 1909, pp. 97-104, plt. vi.

Snodgrass, R. E.—The Thorax of Insects and the Articulation of the Wings. Proc. U.S. Nat. Mus., 1909, vol. xxxvi, pp. 511-595, plts. 40-69.

This is an important paper, though it is doubtful if all will agree with some of the author's opinions. Briefly his conclusions are as follows: Assuming the genuineness of the fourth head segment, the head of insects is composed of six consolidated primary segments. The microthorax is the neck segment of the adult. The thorax proper consists of three segments, which are primary metameres, and there is no real evidence of each

having been formed through a fusion of two or more primitive segments. The original thoracic region may have consisted of more than three segments, but if so, the extra segments have disappeared. The thoracic sclerites conform to one general plan, which the author represents diagrammatically. The primitive tergum is a single undivided plate from the entire lateral margins of which the wings arise. The wing is hinged to the notum on the two notal wing processes, and is supported from below upon the wing process of the pleurum.

Incidently a number of interesting points are brought forward in the review of the special characters of the Orders. Verhoeff's view that the Thysanura are not insects "progenitori," but a degenerate branch of the primitive wingless insects, is regarded as the correct one. In the opinion of many this author's excellent work scarcely warrants his conclusions, and personally, in the light of more recent work, we dissent from this opinion.

The author has made a most valuable addition to the literature on insect anatomy, and has fully illustrated all points in wonderful detail.

W. E. C.

Stitz, H.—Der Genitalapparat der Neuropteren und seine Bedeutung für die Systematik derselben. SB. Gesell. naturf. Freunde, 1909, pp. 91-99, 10 figs.

III.—General and Systematic Biology, and Geographical Distribution.

Austen, E. E.—Notes on the Examination of Batches of Flies received from various centres in London, during the Summer and Autumn of 1908. Rpts. Local Gov. Bd., n.s. No. 5, 1909, p. 4, with table and plate.

Bagnall, R. S.—On *Urothrips paradoxus,* a new type of Thysanopterus Insects. Ann. Mus. Nat. Hungarici, 1909, vii, pp. 125-136, T. iii.

The author describes as new two interesting specimens collected in German East Africa, which are placed in a new Family, the *Urothripidae.*

Urothrips paradoxus, gen. et. sp. nov., possesses seven-jointed antennae, and single jointed maxillary and labial palpi, and there are eleven pairs of stigmata.

Bagnall, R. S.—On the Thysanoptera of the Botanical Gardens, Brussels. Ann. Soc. Entom. Belgique, 1909, T. liii, pp. 171-176.

The following new species are described: *Euthrips longipennis,* and *Cephalothrips spinosus.*

Bainbridge, May E.—Notes on some Parasitic Copepoda. Trans. Linn. Soc. Lond. (2nd ser. Zool.), 1909, vol. xi, pp. 45-60, plts. 8-11.

Baker, C. F.—Studies in *Oxybelidae* I. Pomona Journ. Entom., 1909, vol. i, pp. 27-30.

Bezzi, M.—Le specie dei generi *Ceratitis, Anastrepha e Dacus.* Boll. Lab. Zool. R. Sc. Agric. Portici, 1909, vol. iii, pp. 271-313.

Bezzi, M. Gli scritti cecidologici del Prof. A. Costa. Marcellia, 1909, vol. viii, pp. 19, 20.

Blunck, H. -Färbungsvariation bei *Dytiscus marginalis,* Linn. Zool. Anz., 1909, Bd. xxxiv, pp. 337-345.

Borelli, A.—Scorpioni raccolti dal Prof. F. Silvestri nell' America settentrionale e alle isole Hawaii. Boll. Lab. Zool. R. Sc.. Agric. Portici, 1909, vol. iii, pp. 222-227.

Vaejovis silvestrii is described as a new species.

Borelli, A.—Forficole raccolte dal Prof. F. Silvestri nell' America settentrionale e nelle isole Hawaii. Ibid., pp. 314-328, 3 figs.

The following are described as new : *Anisolabis eteronoma, A. aporonoma, Paracosmia* (n. gen.) *silvestrii,* and *P. dugesi.*

Börner, C.—Über Chermesiden. V. Die Zucht des Reblaus-Wintereies in Deutschland. Zool. Anz., 1909, Bd. xxxiv, pp. 13-29.

Börner, C.—Neue Homologien zwischen Crustaceen und Hexapoden. Die Bei mandibel der Insekten undihre phylogenetische Bedentung. Archi-und Metapterygota. Zool. Anz., 1909, Bd. xxxiv, pp.100-125, 9 figs.

Börner, C.—Japans Collembolenfauna. SB. Gesell. naturf. Freunde, 1909, pp. 99-135.

The following are described as new: *Protaphorura granulata, P. conjungens, Homaloproctus* (n.gen.) *sauteri, Odontella thauma, Achorutes japonicus, A. pterothrix, Proisotoma lamelligera, Isotoma negishina, I. carpenteri, I. occulta, I. pinnata* with vars. *v-album, melanocephala, coracina,* and *fasciata, I. gracilliseta, Pteronychella* (n.gen.) *perpulchra, Tomocerus cuspidatus, Pogonognathus beckeri, Entomobrya villosa, E. striatella, E. corticalis* (Nic.) v. nov. *affinis, E. amethystina, E. stenonyx, E. sauteri* with vars. *allospila* and *depicta, Ptenura bimaculata, Pseudosira gigantea, Cremastocephalus bicinctus, C. affinis,* Folsom, v. nov. *concolor, Sminthurinus fenestratus, Spyrotheca multifasciata* (Reut.), v. nov. *ornata, Sminthurus sensibilis, S. serrulatus, Dicyrtomina leptothrix, Dicyrtoma chloropus* (Tullb.), v. nov. *pallens, Ptenothrix corynophora* with n.vars. *sellata* and *cincta, P. denticulata* (Folsom), v. nov. *catenata,* and *P. setosa* (Krausb.), with n. vars. *picta* and *janthina.*

There are no figures of any of the species or varieties.

Buffa, P.—Contribuzione alla conoscenza dei Tisanotteri. Boll. Lab. Zool. R. Sc. Agric. Portici, 1909, vol. iii, pp. 193-196, 3 figs.

The following two new genera and species are described and figured : *Amphibolothrips grassii* and *Bebelothrips latus.*

Cockerell, T. D. A.—Descriptions of some Bees in the U.S. National Museum. Proc. U.S. Nat. Mus., 1909, vol. xxxvi, pp. 411-420.

Cognetti de Martiis, L.– Contributo alla conoscenza della drilofauna delle isole Hawaii. Boll. Lab. Zool. R. Sc. Agric. Portici, 1909, vol. iii, pp. 265-268, fig. 1.

Pheretima silvestrii, n.sp.

De Stefani Perez, T.—Altri Zoocecidii dell' Eritrea. Marcellia, 1909, vol. viii, pp. 7-18.

Ellingsen, Edv.—On some North American Pseudoscorpions collected by Dr. F. Silvestri. Boll. Lab. Zool. R. Sc. Agric. Portici, 1909, vol. iii, pp. 216-221.

Pseudogarypus is described as a new genus to contain the *Garypus bicornis* of Banks. *Ideobisium tacomense,* n. sp. is also described.

Enderllein, G.—Neue Gattungen und Arten nordamerikanischer Copeognathen. Boll. Lab. Zool. R. Sc. Agric. Portici, 1909, vol. iii, pp. 329-339, 4 figs.

The following are described as new : *Graphopsocus mexicanus, Dasydemella* (n.gen.) *silvestrii, Caecilius mexicanus, C. podacrophaeus, Myrmicodipnella* (n.gen.) *aptera,* and *Troctes prenolepidis.*

Essig, E. O.—Notes on Californian Coccidae II. Pomona Journ. Entom., 1909, vol. i, pp. 31-34, 5 figs.

Essig, E. O.—The Genus *Pseudococcus* in California. Ibid., pp. 35-46, 11 figs.

Essig, E. O.—*Aphididae* of Southern California II. Ibid., pp. 47-52, 4 figs.

Essig, E. O., and Baker, C. F.—Host Index to Californian Coccidae. Ibid., pp. 53-70.

Gestro, R.—Materiali per lo studio delle *Hispidaae.* Boll. Lab. Zool. R. Sc. Agric. Portici, 1909, vol. iii, pp. 197-204.

The author treats of the genera *Brachispa* and *Xiphispa,* describing the following new species : *B. spinosissima,* and *X. latirostris.*

Grevillius, A. Y.—Ein Thysanopterocecidium auf *Vicia cracca,* L. Marcellia, 1909, vol. viii, pp. 37-45, figs. 1-4.

Griffini, A.—Le *Gryllacris* papuane ad ali bicolori. Boll. Lab. Zool. R. Sc. Agric. Portici, 1909, vol. iii, pp. 207-215.

The following species are described as new : *G. kirbyi, G. giulianettii,* and *G. punctipennis,* Walker, sub-sp. *dempwolfii.*

Imms, A. D.—On a new Species of Symphyla from Himalayas. Journ. Linn. Soc. Zool., 1909, vol. xxx, pp. 252-255, plt. 31.

Jepson, F. P.—Some Observations on the Breeding of *Musca domestica* during the winter months. Rpts. Local Gov. Bd., n.s. No. 5, 1909, pp. 5-8.

Kieffer, J. J. u, Herbst, P.—Ueber einige neue Gallen und Gallenerzeuger aus Chile. Centrabl. f. Bakter., 1909, pp. 119-126, 7 figs.

Leigh, H. S.—Preliminary Account of the Life-history of the Leaf Insect, *Phyllium crurifolium,* Serville. Proc. Zool. Soc. Lond., 1909, pp. 103-113, plt. 28.

Leonardi, G.—Altre notizie intorno alla *Diaspis pentagona,* Targ., ed al modo di combatteria. Boll. Lab. Zool. R. Sc. Agric. Portici, 1909, vol. iii, pp. 12-21.

Leonardi, G.—Seconda Contribuzione alla conoscenza delle Cocciniglie Italiane. Ibid., pp. 150-192, 64 figs.

The following are new : *Orthezia martelli, Kermes bacciformis, Phenacoccus graminicola, P. formicarum, Pseudococcus myrmecarius, P. longipes, P. cycliger, Ripersia libera, R. sardiniae, R. inquilina, R. hypogea, Eulecanium cecconi, Lecanopsis mirmecophila, Chionaspis strusca,* and *Hemiberlesia cecconi.*

Martelli, G.—Contribuzioni alla conoscenza della *Dicranura vinula,* L., e di alcuni suoi parassiti. Boll. Lab. Zool. R. Sc. Agric. Portici, 1909, vol. iii, pp. 239-260, 12 figs.

Martelli, G.—Notizie sall' *Eurytoma strigifrons,* Thoms., parassita dell' *Apanteles glomeratus,* Reinh., e dell' *Anilastus ebeninus,* Thoms. Ibid., pp. 261-264.

Masi, L.—Contribuzioni alla conoscenza dei Calcididi Italiani. Boll. Lab. Zool. R. Sc. Agric. Portici, 1909, vol. iii, pp. 86-149, 45 figs.

The following are new : *Encyrtus mayri, Aphicus philippiae, Chalcis modesta, Habrocytus distinguendus, Pseudocatolaccus* (n.gen.) *asphondyliae, Prospalta coniugata,* and *P. similis.*

Morley, Claude.—Observations on the Economy of the *Ichneumon manifestator,* Marsham (nee Linn.). An Historical Note. Journ. Linn. Soc., Zool., 1909, vol. xxx, pp. 271-274.

Nalepa, A.—Eine Gallmilbe als Erzeugerin der Blattgallen von *Cinnamomum zeylanicum,* Breyn. Marcellia, 1909, vol. viii, pp. 3-6.

Nalepa, A.—Der Erzeuger des *Erineum padinum,* Duv. Marcellia, 1909, vol. viii, pp. 45-48.

Petri, L.—Ueber die Wuzzelfäule phylloxerieter Weinstöcke. Zeit. f. Pflanzekkr., 1909, Bd. xix, pp. 18-48, 13 figs.

Reuter, E.—*Physopus basicornis,* n.sp. Marcellia, 1909, vol. viii, pp. 35, 36, 1 fig.

Silvestri, F.—Miriapodi. Dell' opera Il Ruivenzori rel. sci., 1909, vol. i, pp. 3-39, 89 text figs.

Silvestri, F.—Termitidae. Ibid., pp. 1, 2.

Silvestri, F.—Descrizione e cenni biologici di una nuova specie di *Asphondylia* dannosa al lupino. Boll. Lab. Zool. R. Sc. Agric. Portici, 1909, vol. iii, pp. 3-11, figs. i-xi.

Silvestri, F.—Appunti sulla *Prospalta berlesei,* How., e specialmente sui primi stati del suo sviluppo. Ibid., pp. 22-28, figs. i-vi.

Silvestri, F.—Contribuzioni alla conoscenza biologica digli Imenotteri Parassiti. Ibid., pp. 29-85, T. i, ii, figs. i-xlvi.

The three species treated of are *Ageniaspis fuscicollis* (Dalm.)., *Encyrtus aphidivorus,* Mayr., and *Oophthora semblidis,* Aur.

Silvestri, F.—A proposito di certe osservazioni sulla Tignola dell' olivo. Ibid., pp. 340-342.

Trotter, A.—Nuovi Zoocecidii della Flora Italiani. Marcellia, 1909, vol. viii, pp. 50-59, 2 figs.

Trotter, A.—Breve descrizione di alcune galle europee ed esotiche. Ibid., pp. 59-64.

van Leeuwen-Relinvaan, J. u. W. D.—Einige Gallen aus Java. Marcellia, 1909, vol. viii, pp. 21-35, figs. 1-17.

Weise, J.—Eine neue Coccinellide aus Mexico. Boll. Lab. Zool. R. Sc. Agric. Portici, 1909, vol. iii, pp. 205, 206.

Hyperaspis silvestrii, n.sp.

Wheeler, W. M.—Ants collected by Prof. F. Silvestri in Mexico. Boll. Lab. Zool. R. Sc. Agric. Portici, 1909, vol. iii, pp. 229-238.

The collection comprises an unusual number of interesting forms, amongst which there is a new and abberrant species of *Megalomyrmex* (*M. silvestrii*) and two other species, *Cremastogaster formosa* and *Ectatomma interruptum,* which do not seem to have been taken since they were described many years ago by Mayr.

Wheeler, W. M.—Ants collected by Prof. F .Silvestri in the Hawaiian Islands. Ibid., pp. 269-272.

Cerapachys (Syscia) silvestrii, n.sp.

Williams, F. X.—The Montery Pine Resin Midge, *Cecidomyia resincoloides,* n.sp. Entom. News, 1909, vol. xx, pp. 1-3, 1 plt.

Wilson, C. B.—Dragonflies of the Mississippi Valley collected during the Pearl Mussel Investigations on the Mississippi River, July and August, 1907. Proc. U.S. Nat. Mus., 1909, vol. xxxvi, pp. 653-671.

IV.—Agriculture and Horticulture.

Aldrich, J. M.—Western Spread of the Colorado Potato Beetle. Journ. Econ. Entom., 1909, vol. 2, p. 235.

Ballou, H. A.—The Flower-bud Maggot of Cotton. W.I. Bull., 1909, vol. x, pp. 1-28, 9 figs.

This pest is the larva of *Contarinia gossypii*, Felt, and a full account of the life-history is given. The remedial measures tried strike us as particularly weak. Turning the soil over to a depth of six or eight inches would we think prove as successful here as it has done with *Diplosis pyrivora*.

Buchman, E. R.—The Gum produced by *Bacillus radicicola*. Centrlbl. f. Bakter., 1909, Bd. xxii, pp. 371-396.

Butler, E. J.—The Mulberry Disease caused by *Coryneum mori*, Nom., in Kashmir, with Notes on the other Mulberry Diseases. Mem. Dept. Agric. India, Bot. Ser., 1909, vol. ii, No. 8, pp. 1-18, plts. i-iv, and 3 text figs.

The author gives a full account of this disease and also of the Mulberry Leaf Spot (*Septogloeum mori*), Mulberry Mildew (*Phyllactinia corylea*), and Mulberry Trunk-rot (*Polyporus hispidus*), all of which are well illustrated.

Chittenden, F. H.—The Rose-chafer. (*Macrodactylus subspinosus*, Fab.). U.S. Dept. Agric., Bur. of Entom., Circ. No. 11, rev., 1909, pp. 1-4, 1 fig.

Chittenden, F. H.—The Striped Cucumber Beetle (*Diabrotica vittata*, Fab.). U.S. Dept. Agric., Bur. of Entom., Circ. No. 31, 2nd rev., 1909, pp. 1-8, 2 figs.

Chittenden, F. H.—The Hop Flea-beetle (*Psylliodes punctulata*, Melsh.). U.S. Dept. Agric., Bur. of Entom., Bull. No. 66, pt. vi, 1909, pp. 1-92, plts. v-vii, and 19 figs.

Conradi, A. F., and Thomas, W. A.—Some Injurious Orchard Insects. Sth. Carolina Agr. Exp. Stat., Bull. 143, 1909, pp. 1-35 figs. 1-15.

Crosby, C. R.—On Certain Seed-infesting Chalcis-flies. Cornell Univ. Agric. Exp. Stat., Bull. 265, 1909, pp. 367-388, figs. 72-98.

Details the life-history of *Syntomaspis druparum*, Bohe., *Megastigmus brevicaudis*, Ratz., *M. aculeatus*, Swed., *M. spermotrophus*, Wachtl., *Evoxysoma vitis*, Saunders, *Prodecatoma phytophaga*, Crosby, and *Eurytoma rhois*, Crosby.

Davis, R. A.—Phylloxera-resistant Vines for the Transvaal. Transv. Agric. Journ., 1909, vol. vii, pp. 463-470, plt. 69, and 6 text figs.

Doane, R. W.—Notes on Insects affecting the Cocoanut Trees in the Society Islands. Journ. Econ. Entom., 1909, vol. 2, pp. 220-223.

Evans, I. B. P.—Maize Smut or "Brand." Transv. Agric. Journ., 1909, vol. vii, p. 445, plt. 66.

Evans, I. B. P.—Peach Freckle or Black Spot. Transv. Agric. Journ., 1909, vol. vii, p. 446, plt. 67.

Fawcett, H. S.—Scaly Bark of Citrus. Florida Agric. Exp. Stat., Bull. No. 98, 1909, pp. 73-80, figs. 1-3.

Fawcett, H. S.—Fungi Parasitic upon *Aleyrodes citri.* Univ. State of Florida. Thesis., 1908, pp. 1-41, plts. i-vii, 19 text figs.

The author shows that there are at least six species of fungi parasitic upon *Aleyrodes citri,* of these *Aschersonia aleyrodis,* Webber, is the most widely distributed parasite. It is easily isolated and grown in pure cultures. Healthy larvae of *A. citri* may be infected by spraying a mixture of conidia in water on infested trees.

Fletcher, J.—Report of the Entomologist and Botanist for the Year ending March 31st, 1908. Ann. Rpt. Exp. Farms 1907-8, 1909, pp. 2 + 183-213, 1 plt.

Forbes, S. A.—The general entomological Ecology of the Indian Corn Plant. Amer. Nat., 1909, vol. 43, pp. 286-301.

Froggatt, W. W.—So-called Fruit-flies that are not Fruit-flies. Agric. Gaz. N.S.W., 1909, vol. xx, pp. 364-369.

Gahan, A. B.—A Moth larva predatory upon the eggs of the Bagworm. Journ. Econ. Entom., 1909, vol. 2, pp. 236, 237.

Gates, B. N.—Bee Keeping in Massachusetts. U.S. Dept. Agric., Bur. of Entom., Bull. No. 75, pt. vii, 1909, pp. 81-109.

Grossenbacher, J. G.—A *Mycosphaerella* Wilt of Melons. N.Y. Agric. Exp. Stat. Geneva, Tech. Bull. No. 9, 1909, pp. 195-229, plts. i-vi.

The pathogeneity of the fungus (*M. citrullina,* C. O. Sm.), and the relation of its two spore-forms are established. Inoculation experiments were effective, and, with but a few interesting exceptions, the spore-forms of the fungus always appeared successively on the inoculated vines.

Gunn, D.—The Root Louse of Grape Vines (*Phylloxera vastatrix,* Planchon.). Transv. Agric. Journ., 1909, vol. vii, pp. 508-512, plts. 79, 80, and 2 text figs.

Hammar, A. G.—The Cigar Case-bearer. (*Coleophora fletcherella,* Fernald.). U.S. Dept. Agric., Bur. of Entom., Bull. No. 80, pt. ii., 1909, pp. 33-34, plt. i, ii, figs. 9-12.

Hayhurst, P.—Quack Grass (*Agropyron*), a Host of the Hessian Fly. Journ. Econ. Entom., 1909, vol. 2, pp. 231-234.

Headden, W. P.—Arsenical Poisoning of Fruit Trees. Journ. Econ. Entom., 1909, vol. 2, pp. 239-245.

Howard, A. and G. L. C.—The Varietal Characters of Indian Wheats. Mem. Dept. Agric. India, Bot. Ser., 1909, vol. ii, No. 7, pp. 1-66.

Howard, L. O., and Chittenden, F. H.—The Leopard Moth. (*Zeuzera pyrina*, Fab.). U.S. Dept. Agric., Bur. of Entom., Circ. No. 109, 1909, pp. 1-8, figs. 1, 2.

Howard, L. O., and Chittenden, F. H.—The Green-striped Maple Worm. (*Anisota rebicunda*, Fab.). U.S. Dept. Agric., Bur. of Entom., Circ. No. 110, 1909, pp. 1-7, figs. 1-3.

Jenne, E. L.—The Codling Moth in the Ozards. U.S. Dept. Agric., Bur. of Entom., Bull. No. 80, pt. 1, 1909, pp. 1-32, 8 figs.

Kelly, A.—Some Notes on the Diseases of the Potato Crop in Natal. Natal Agric. Journ., 1909, vol. xii, pp. 427-435, plts. i-iii.

Lefroy, H. M.—Eri or Castor Silk. Agric. Journ. India, 1909, vol. iv, pp. 125-133, plts. vi-xiii.

Mally, C. W.—Poisoned Bait for Fruit Fly. Agric. Journ. C. of G.H., 1909, vol. xxxiv, pp. 620-623, 1 plt., 5 text figs.

The following formula was used with excellent results:—sugar, 3lbs., arsenate of lead, 4ozs., water, 5galls. Fourteen applications were given, and the cost of materials worked out at about 4d. per tree, minus labour.

Rolfs, P. H., and Fawcett, H. S.—Fungus Diseases of Scale Insects and Whitefly. Florida Agric. Exp. Stat., Bull. No. 94, 1908, pp. 1-17, figs. 1-21.

The authors of this interesting paper point out that no danger need be anticipated from any of the scale-destroying fungi, as none of them attack fruit or other trees. Amongst the species experimented with are *Sphaerostilbe coccophila*, Tub., *Ophionectria coccicola*, E. and E., *Myraingium duriaei*, Mont., *Aschersonia flavocitrina*, *A. aleyrodis*, Webber, and a brown fungus of the Whitefly.

These six species have been known for years and used successfully. The peculiar life habits of scale insects and whitefly larvae make them especially liable to attacks of fungus diseases. Treating orchard pests by means of their diseases is regarded as the natural method, and hence the desirable one.

Silvestri, F.—Sguardo allo stato attuale dell' Entomologia Agraria Stati-Uniti del Nord America. Boll. Soc. Agric. Italiani, 1909, vol. xiv, pp. 1-65.

Sutton, Geo. L.—Treatment for Smut. Agric. Gaz. N.S.W., 1909, vol. xx, pp. 436-441, 3 figs.

Thomsen, F.—Notes on Termites. Transv. Agric. Journ., 1909, vol. vii, pp. 512-520, 1 fig.

Thomsen, F.—The Brown Locust Campaign, 1908-09. Transv. Agric. Journ., 1909, vol. vii, pp. 521-526, plts. 81-83.

Thornton, R. W.—Take-all or Whiteheads in Wheat. (*Ophisbolus graminis*). Agric. Journ. C. of G.H., 1909, vol. xxxiv, pp. 526, 527.

Truelle.—L'emploi des composés arsenicaux en arboriculture aux Etats-Unis. Bull. Agric. de l'Algérie, 1909, pp. 230-238.

Webster, F. M.—The Spring Grain-Aphis or so-called "Green Bug." U.S. Dept. Agric., Bur. of Entom., Circ. 93, rev., 1909, pp. 1-22, 10 figs.

Webster, F. M., and Reeves, G. I.—The Wheat Strawworm (*Isotoma grande*, Riley.). U.S. Dept. Agric., Bur. of Entom., Circ. No. 106, 1909, pp. 1-15, 13 figs.

Wilson, C. S., and Reddick, D.—The Black Rot of the Grape and its Control. Agric. Exp. Stat. Cornell Univ., Ithaca, Bull. 266, 1909, pp. 391-411, figs. 99-110.

Woglum, R. S.—Fumigation Investigations in California. U.S. Dept. Agric., Bur. of Entom., Bull. No. 79, 1909, pp. 1-73, 28 figs.

V.—Forestry.

VI.—Fisheries.

VII.—Medicine.

Anon.—Does Malaria ever occur Epidemically without the Agency of Anophelines? Lancet, 1909 (July 24th), pp. 237, 238.

Werner, H.—Studies regarding Pathogenic Amoebae. Ind. Med. Gaz., 1909, vol. xliv, pp. 241-245, 7 plts.

A useful translation by Dr. W. D. Sutherland, from the "Archiv. v Schiffs und Tropenhygiene."

THE

JOURNAL OF ECONOMIC BIOLOGY.

SOME NOTES ON THE DISTRIBUTION OF *GLOSSINA PALPALIS*, ROB-DESV.

By

S. A. NEAVE, M.A., B.Sc.

With Map.

The following notes on the distribution of *Glossina palpalis*, Rob-Desv, refer more particularly to the South-Eastern limit of the distribution of that species as at present known. They were made during more than four years travelling in Northern Rhodesia and in the Katanga or South-Eastern district of the Congo Free State. Some of these notes, especially those relating to Katanga, have already been published in the report of the Katanga Medical Commission, and embody the views published by Dr. Sheffield Neave in the body of that report and by myself in the Annexe No. 1 thereto. Since, however, that report has had a limited circulation, and I am now in possession of more facts relating to Northern Rhodesia, it is perhaps expedient, in view of the importance of the question, to discuss the matter again.

A considerable study of the general fauna of this part of Africa, shows it to be of great interest, and to be the meeting place of two or more zoological regions. I hope to deal with this question more fully elsewhere, when some account of my general zoological collections is published. Before recounting the details of the distribution of *G. palpalis*, it is necessary to give some description of the geography of the country. The chief geographical feature of this region is the great Congo Zambezi watershed, which is never of much less elevation than 4,500 feet. Starting from the boundary of German East Africa, it extends through N.E. Rhodesia in a south-westerly direction. About Lat. 13 S. it turns westward, and forms the boundary between the Congo Free State and N.W. Rhodesia as far as the Angolan frontier. The fauna of this high plateau country,

which is often very wide on both sides of the watershed, has affinities with that of areas of similar elevation in Southern Angola and the regions of the great lakes further north. Descending off this plateau into the *Zambezi* basin, one finds a fauna which is mainly *South African* in character; on the *Congo* side of the watershed, on the other hand, at the same elevations, the fauna begins at once to assume the characteristics of that of the Western Tropical regions.

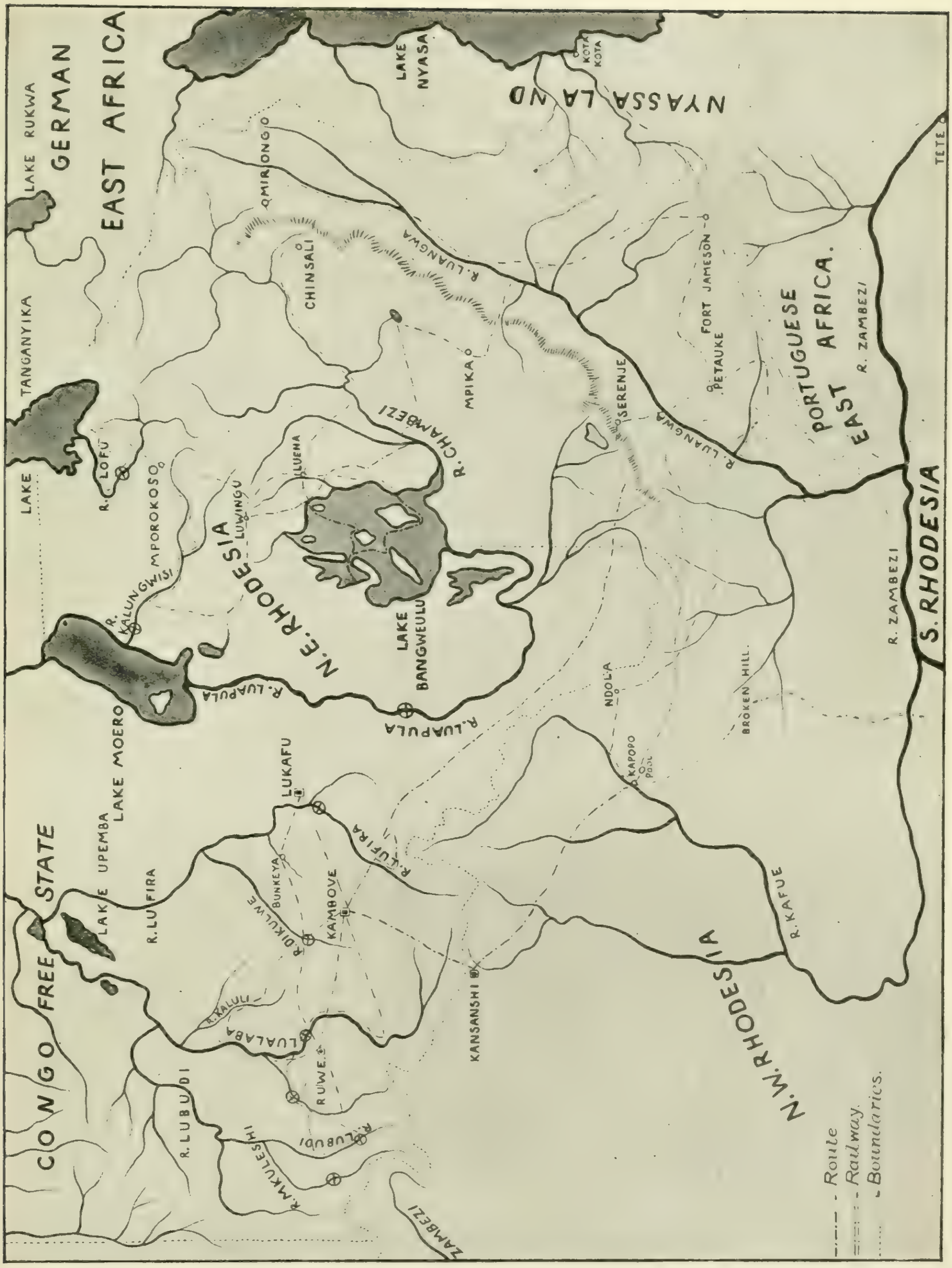
Now *Glossina palpalis*, so far as at present known, occurs *only* in this region, on the rivers and lakes of the Congo side of the watershed up to some point between 3,000 and 3,500 feet. Further, it closely coincides in its range with that of the Western Tropical fauna above mentioned.

The accompanying sketch map shows approximately the highest points on the Congo rivers on which *G. palpalis* is known to occur.

The next point of importance is the character of the river banks in these regions; a factor of the greatest importance in determining the presence or absence of *palpalis*, at least on the edge of its distribution.

In the high plateau country, near the watershed in both the Congo and Zambezi basins, the larger rivers run through more or less flat country in deep perennial channels. The banks are, for the most part, grassy, though occasionally moderately wooded. This description applies to the upper waters of all the plateau rivers, besides the whole of the Chambezi river and the shore of L. Bangweolo.

In the Zambezi basin, on the lower ground, the rivers run in wide, shallow, and sandy beds, the banks being often largely covered with Phragmites reed. In these rivers, of which the Luangwa may be taken as typical, the channel is only filled when the river is in flood at the height of the wet season. At other seasons the river is very shallow, and leaves exposed sandbanks and islands, often of considerable size. In no part of this area can we say with certainty that *G. palpalis* has been found. It is true that there are in the National Collection the four historic specimens (now considered to be intermediate between typical *G. palpalis* and its form *wellmani*, Aust.), supposed to have been collected by Sir John Kirk on the Upper Zambezi in 1864. We must remember, however, the fact that the specimens, which are in bad condition, date from a time when modern views in Museums as to the primary importance of labels were not in existence. Further, no other specimens are known from the whole of the Zambezi Valley, in spite of that region being now vastly better known. Judging also by the British Museum series the form *wellmani*, Aust., must be considered the southern race of



SKETCH MAP OF NORTHERN RHODESIA, ETC., showing the known limits of the distribution of *Glossina palpalis*. The highest point on the rivers, at which the insect has been found, is marked O.

palpalis. Except for one intermediate from L. Tanganyika, which apparently occurred among typical *wellmani*, all *palpalis* of the type form, as well as intermediates toward *wellmani*, in the National Collection, come from much further north and west. In these circumstances we should certainly expect Zambezi specimens, if genuine, to be *wellmani*.

We are, I think, on the whole justified in considering the former existence of a form of *palpalis* in the Zambezi Valley as non-proven, more especially as no explanation of its entire disappearance from the Zambezi Valley has been offered.

To return to the Congo side of the region under discussion. As the sketch map shows the more important rivers from west to east are the Lubudi, Lufupa, Lualaba, Dikulwe, Lufira, Luapula, Kalungwisi, and Lofu.

On descending from the high ground, the points at which *G. palpalis* makes its appearance on the banks of these rivers have a marked relationship to the geographical features. After a course of varied length through flat plateau country, these rivers usually descend rather abruptly through a series of gorges into the lower ground. At this point the banks begin to become heavily wooded, and *it is at these points*, usually near the top of the gorge, where present, that *palpalis begins to appear*, as also do the other insects characteristic of the Western Tropical Region, as mentioned above. It should be noted that *below* these points *palpalis* seems to occur wherever the banks are suitable. There are sometimes gaps in the distribution of the insect on the lower ground where the river passes through flat alluvial plains with grassy banks. In the case of the Lubudi River, and also, I understand, of the Luapula (the only one I have not personally visited), the descent of the river from the high ground is much more gradual. In these cases the point where the insect first appears, is *not* accompanied by any marked change in the character of the well-wooded banks. This fact, if correct, emphasizes the importance of *elevation* as the primary factor in checking the range of the species. The Kalungwisi River, in N.E. Rhodesia, presents an interesting abnormality to the above rule. On this river *palpalis* occurs for some 10 to 15 miles at its mouth, possibly representing an infection from the shores of Lake Mweru. Some thirty miles further up the river passes through a considerable stretch of broken country. In this area, which is in every way suitable to it, being densely forested, and harbouring many insects of the Western Tropical region, I could find no trace of it. It is true that there is a flat plain of considerable size, where the river has grassy banks between this point and the *palpalis* haunted area near

the mouth, but there would also appear to be some anti-*Glossina* factor in the Kalungwisi valley. *G. morsitans,* Westw., though game is very plentiful, seems to be also entirely absent therefrom. This is all the more remarkable, as only some 30 to 40 miles to the N.E., in the valley of the Lofu, both species of *Glossina* are extremely plentiful. What this factor may be, it seems impossible at present even to suggest. Some knowledge of it would perhaps provide an explanation of the strange belts and patches in which *morsitans* occurs.

Though not germane to the subject of these notes, there is one point of interest in the habits of *G. palpalis* which is perhaps worth mentioning. Theobald has recently suggested[1] that *G. palpalis* is perhaps confined to the neighbourhood of rivers, etc., from the necessity of having to constantly drink water. Personally, I think that this is more probably due to an instinctive dislike of the insect to leave areas where the atmosphere is of the humidity necessary for the development of its offspring. It was nevertheless of interest in this connexion to find in Katanga that some of our natives, when bribed to collect *palpalis* where it was scarce, used to sit on the river bank, after having wetted their legs in the water. This provision of a wet surface, on which the insect could conveniently absorb moisture, certainly proved an attraction to it.

To sum up, *G. palpalis*, at least on this, the south-eastern edge of its distribution, is confined to the well-wooded river banks and lake shores of the Congo basin up to about 3,400 feet. It is not *known* to occur at similar elevations in the basin of the Zambezi, where the insect fauna generally is certainly different. The chief barrier to its southern spread, apart from the character of the river bank, seems to be elevation above sea level. This barrier is here provided by the great area of high plateau forming the Congo-Zambezi watershed.

Attention has recently been called to the possibility of infection of the Zambezi valley by this barrier being crossed by the projected railways now advancing northward. Though this state of things seems hardly likely in the immediate future, it has certainly to be provided against. Whether, if artificially introduced into the Zambezi Valley, *G. palpalis* could survive there, seems an impossible question to answer until we know more of the factors which are essential to its well being. A vast part of the mid and lower Zambezi Valley seems to be totally unsuitable to it. Whether, however, this insect could exist in such places as the neighbourhood of the Victoria Falls or the Kabroabasa Rapids of the lower Zambezi is less certain.

[1] Bulletin of the Sleeping Sickness Bureau, pt. 6, p. 245.

THE LIFE-HISTORY OF *CALLIDIUM VIOLACEUM* (LINN.).

By

JOHN W. SHOEBOTHAM, N.D.A.

With Figures 1-12.

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I.—Introduction.

Soon after coming to Berkhamsted in 1908, I found that some of the wooden fences in the neighbourhood were being bored and seriously damaged by some insect, but at the time the actual cause of the injury was not ascertained, as no insect could then be found. About the middle of May, beetles were found emerging from the borings, and these were caught and kindly identified for me by Mr. Walter E. Collinge, M.Sc., as *Callidium violaceum* (Linn.).

An extended inspection of the fences in the district, showed that the beetle had done, and was still doing, considerable damage, and as no account of the attack could be found in English economic literature, excepting an early paper by Kirby,[1] its life-history was worked through, an account of which is given in the following pages.

He records some observations made by Mr. James Trimmer of Old Brentford, of an attack on Spruce and Scotch Fir. His account of the life-history is in accord with that given here, but he is mistaken in describing the larva as legless.

Mr. Trimmer observed the female to lay her eggs on apple, pear, plum, and cherry, but does not say whether these developed. In the case on the Spruce the beetles emerged from the 20th of May to the 20th of June.

[1] Kirby, Rev. William.—" Some Observations on Insects that prey upon Timber, with a short History of the *Cerambyx violaceus* of Linnaeus." Linn. Trans. (read Nov., 1799), vol. v, p. 246-260, with pl. 12.

The fact that the larvae live under the bark made the investigation less easy, but these have been bred in the Laboratory in addition to observations on them in the field.

My best thanks are due to Mr. Walter E. Collinge, M.Sc., for the identification of the beetle and for other generous assistance throughout the inquiry.

II.—Systematic Position.

The following shows the systematic position of the species amongst the Coleoptera:—

Group: Longicornia.
Family: **Cerambycidae.**
Tribe: **Cerambycina.**
Genus: **Callidium,** Fab.
Species: *violaceum*, Linn.

As no English name, that I am aware of, has been applied to this beetle, it might be called "The Flat Violet Beetle."

III.—Life-History and Habits.

There is a certain amount of variation in the life-history, which is noticeable in the larval stage, as amongst larvae from the same batch of eggs, some were ready to pupate, when others were little more than half grown.

The adult beetles emerge from the borings during the middle and latter part of May, and the beginning of June (rather earlier in 1908 than 1909). They may be seen on the rails and posts, and flying from one to the other, especially when the sun is out.

(*a*) *The Egg.*—Copulation takes place, and the female commences to lay her eggs under the pieces of rough bark and in crevices. She exercises great care in the selection of suitable positions for placing the eggs, feeling about with her long ovipositor, and often trying several niches before she finds one to suit her.

The number of eggs placed together varies, in one case a female was observed to place eleven eggs under a projecting piece of bark, taking seven minutes to complete the operation. In other cases the eggs were laid singly, or in groups of three or four. In the case of the larger groups, no attempt at arrangement of the eggs was noticed.

The egg (Fig. 1) is elongate-oval, a little broader at one end than the other, white in colour, and devoid of any markings. Length, 1.6 mm., breadth at broadest part, .45 mm.

(*b*) *The Larva.*—After hatching, the larva bores through the bark and commences to eat a narrow channel between the bark and the

wood, eating about equally of each, so that the markings can be seen as well on the bark as the wood. As it grows in size, it eats a gradually widening passage, which it leaves full of bore dust. Where there is only one larva at work on a piece of timber, its course is easily followed and the markings are definite (Fig. 10), but where several are working together, they cross and recross their own or other borings (Fig. 12), so that the markings of each are only traced with difficulty.

A point that was puzzling in tracing the course of the larvae, was that the markings of two separate individuals could be seen up to a certain point, but when one had just crossed the other, it would suddenly come to an end. It is only recently that a probable explanation of this phenomenon has presented itself. After putting

Fig. 1.—Outline of the Egg.

Fig. 2.—Larva, dorsal view.

several of the larvae together in a petri dish, it was noticed that one larva, which was full grown, was keeping very close to a smaller one and making it wriggle. On closer examination it was found that the smaller one had been badly bitten in two places and eventually died. I think it probable, therefore, that this takes place under the bark and so may account for some of the perplexing markings.

When the larva is about half grown, it is not content with eating directly in front of it, but turns to the right and left, eating out large sinuses still between the bark and wood and always within the limits of the piece of timber, though they get very near the edge at times.

When nearly full grown, from the end of September onwards, the larva leaves its position between the bark and the wood and for the first time bores directly into the wood, making a chamber in which to pupate and spend the winter. The entrance to this chamber

is oval, nearly always oblique, and from 4.5 to 7 mm. in length. The boring (Fig. 11) goes straight into the wood for a little way and then gradually curves round and runs parallel to the grain of the wood. The length of the chamber is about 50 mm., and a little broader at the end than at the entrance.

Judeich and Nitsche[1] figure the borings and pupal chamber of an allied species (*Callidium variabile* (Linn.)).

The larva (Fig. 2) is of a creamy white colour, except the head and legs, which are brown, and the mandibles, black. The body segments are well marked, and covered with short golden yellow hairs, which are numerous at the sides of the segments, and almost absent in the middle.

A spiracle is found on each side of the mesothorax, and on the 1st to the 8th abdominal segments. The spiracles are oval in shape

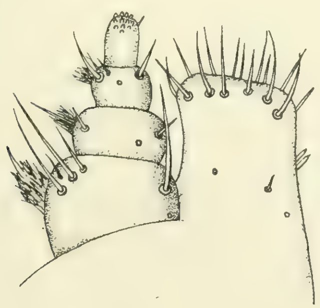

FIG. 3.

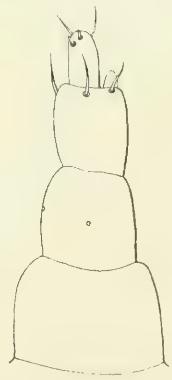

FIG. 4.

Fig. 3.—End of right maxilla and maxillary palp, from below.
Fig. 4.—Left antenna, from above.

and light brown in colour. Head small, much broader than long. Ocelli (Fig. 5) black, two on each side of the head, situated one dorsal and the other ventral to the antenna and mandible. The maxillary palp (Fig. 3) is 4-jointed and conical; 1st joint broader than long, ventrally with three or four long bristles, dorsally with numerous short hairs, and on its outer side with a large tuft of hairs; 2nd joint broader than long, ventrally with two short bristles, laterally with a tuft of hairs and one strong bristle, dorsally with many short hairs; 3rd joint, about as broad as long, with two strong ventral bristles, laterally with a small tuft of hairs, dorsally with short hairs; 4th joint, about as long as the third, but much narrower, ventrally

[1] Lehrbuch der Forstinsektenkunde, 1895, Vol. i, p. 584.

with twelve or thirteen short papillae, dorsally with one short bristle on the inner side. The end of the maxilla has several long bristles on the ventral side and numerous short hairs dorsally.

Antennae (Fig. 4), 4-jointed, 1st joint, broad, without hairs; 2nd joint without hairs in all specimens examined, except one, which had a strong bristle on the outer side; 3rd joint, about equal to 2nd in length, with a blunt-conical protuberance on the inner side and a curved bristle immediately above it. There is also a dorsal bristle and one ventral on the outer side; 4th joint, narrow, like the last joint of the maxillary palp, with two ventral bristles and two short thick dorsal ones.

Prothorax, large, flattened on top, twice as broad as long, and about one and a half times as broad as the 8th abdominal segment. Mesothorax, short, not so broad as the prothorax. Metathorax, similar to the mesothorax, but a little narrower. The pro-meso- and meta-thoracic segments each bear a pair of short legs (Fig. 6), which

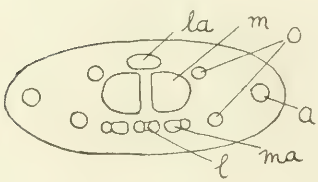

FIG. 5.

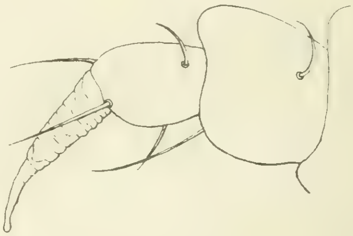

FIG. 6.

Fig. 5.—Diagrammatic view of the head, from in front, to show position of the ocelli, *la*, labrum; *m*, mandible; *o*, ocelli; *a*, antenna; *ma*, maxilla; *l*, labium.

Fig. 6.—Claw and last two joints of the leg.

are brown in colour. Each ends in a single claw, which is tapering, scarcely curving, and has a roughened surface.

The 1st and 2nd abdominal segments are short, about equal to the metathorax in length. In the next five segments, each succeeding segment is a little longer than the previous one and bear fleshy tubercles on the dorsum, which are most noticeable on segments 5, 6, and 7. Tubercles are also present on the ventral side and aid in locomotion.

The 8th segment is partially retractile within the 7th, and the 9th within the 8th. The anal segment is rounded, visible from above, and appears like a 10th abdominal segment.

Length of full grown larva, 16 mm.

(*c*) *The Pupa.*—When the pupal chamber is completed, the larva turns round and pupates with its head towards the entrance, and in

this position passes the winter. In two cases the pupae were found lying free in the bore-dust under the bark, not having made a hole in which to pupate.

The duration of the pupa stage has not been determined with

Fig. 7.—Pupa, dorsal view.

certainty, as those under observation died, but it seems that it passes the winter in this stage, the imagines emerging the following May and June.

Fig. 8.—Imago (female) dorsal view.

The pupa (Fig. 7) is of a creamy white colour. The head is folded under the prothorax and scarcely visible from above. Prothorax large, flattened on the top. The legs are folded up under the body, but the femora can be seen projecting from the sides, especially those of the 3rd pair. The antennae are transparent, and run along

the sides of the thorax, bend over the 2nd pair of legs and turn under the body. The first five abdominal segments bear spiracles.

Fig. 9.—Left wing.

Body without hairs, somewhat flattened, of the same width to the 5th abdominal segment, then gradually tapering behind.

Length of pupa, 9-11 mm.

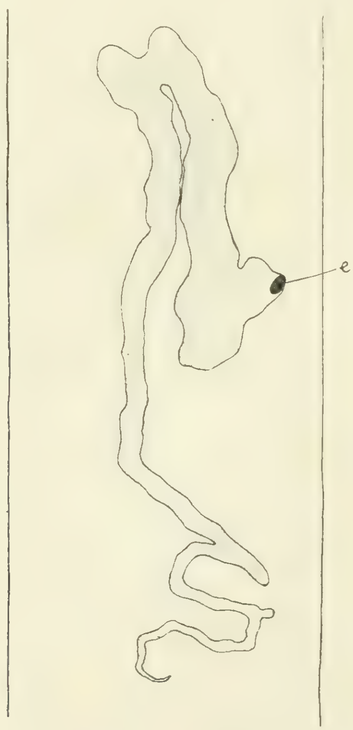

Fig. 10.—Borings of larva on Spruce pale. *e*, entrance to pupal chamber.

(*d*) *The Imago.*—When the beetle is ready to leave the pupal chamber, it bores through any dust left by the larva, and if the bark has peeled off, it can immediately come out, but if the bark is still on,

it has to bore through it from the entrance of the pupal chamber, and then it is free to pair and commence another life-cycle.

Imago (Fig. 8), elongate, flattened, of a dark blue or violet colour. Head, about as broad as one of the elytra, closely and rugosely punctured. Eyes, convex posteriorly, concave anteriorly. Antennae, inserted in front of the hollowed part of the eye, 11 jointed, 1st joint largest, slightly curved, 2nd joint, smallest, less than half as long as the 1st, the next four segments about equal in length, a little less than the 1st, 7th joint, a little less than the 6th, the four terminal segments short, about equal in length, a little longer than the 2nd. All the segments are clothed with hairs, which are stronger and more numerous on the first five segments. The head is covered with short hairs and is a little depressed between the antennae. Prothorax, broader than long, covered with short hairs,

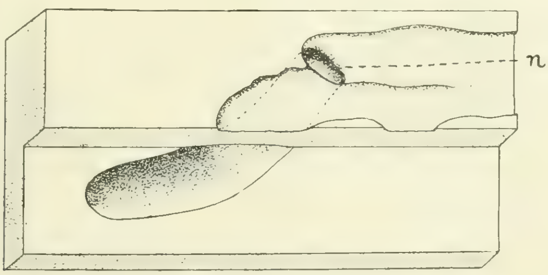

Fig. 11.—Larch, bored by larvae with part cut away to show pupal chamber. *n*, entrance to pupal chamber.

with the sides strongly rounded, punctures coarser than on the head. Elytra, broader than the prothorax, coarsely and rugosely punctured, coarser than on the prothorax, with a single hair arising from each depression, apex rounded. The venation of the wing is shown in Fig. 9. Legs, shiny, long, especially the 3rd pair, femur, flattened and much enlarged, tarsus, apparently 4-jointed, really 5-jointed, the 4th joint being small and fused with the 5th, which ends in two toothless claws. The end of the tibia is furnished with two spines.

Length, 9-14 mm. Length of ovipositor of female, 7 mm.

The males may be distinguished from the females by their smaller size and the relative length of the antennae, which in the male are a little shorter than the body, while in the female they are much shorter.

IV.—Damage Done and Timbers Attacked.

Damage is done in two ways:—

1. By boring between the bark and the wood, and later into the wood, thus weakening the fence.

2. By allowing water and fungi to enter into, and cause the rotting of the wood.

Fig. 12.—Piece of Larch, bored by larvae, showing entrances to six pupal chambers.

This species seems to confine its attention to conifers, the only timbers I have found attacked being larch and spruce. In one case a fence nearly one hundred and fifty yards long had every larch post and rail bored by the larvae, but the few oak posts present were untouched.

A piece of wood badly attacked has the appearance, as shown in Fig 12.

The only case observed on spruce was on a few pales (Fig. 10), and these were only a few yards from some larch rails that were badly attacked.

In the Berkhamsted district, it has not been observed to attack living trees, though in some cases it was ascertained that the wood attacked had been grown and cut up on the estate.

Fowler[1] gives the following records:—"In decaying fir posts and stumps; local, but sometimes abundant; Darenth Wood, Roehampton, Forest Hill, Shirley, Leith Hill, Croydon, Dulwich, Walton, Mickleham, Cowfold, Shiere, Reigate, Shipley, etc.; Lowestoft, Hastings, New Forest, Devon; by hundreds for four or five years in wood of an old summer-house at Cirencester, Binley, near Coventry, and Manchester."

V.—Control.

Nothing can be done in the way of remedial measures unless the damage is detected before the larvae make their way into the wood to pupate. If this can be done, the bark should be stripped off the posts, when the larvae will be dislodged, and exposed to the weather, and for the birds to devour them.

Where badly attacked, the fencing should be pulled down and burnt during the winter, to destroy the pupae.

As a means of prevention, timber used for fencing should be creosoted or painted with tar, to prevent egg laying, it being found that when so treated it is not attacked.

As mentioned by Kirby, timber used for fencing or for wood buildings should have the bark stripped off, as this will prevent egg-laying and subsequent attack.

The Cooper Research Laboratory,
Berkhamsted.
November 8th, 1909.

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[1] British Coleoptera, vol. iv, p. 223.

NOTE ON *AMERUS NORMANI*, CLLGE. & SHB.

By

WALTER E. COLLINGE, M.Sc, F.L.S., F.E.S.

SINCE the publication of the description of the Collembolan named by Mr. Shoebotham and myself *Amerus normani*,[1] we have been fortunate enough in meeting with more and better material, and further examination has led us to the view that this species must be referred to the genus *Megalothorax*, Willem.[2]

In these later examples the head shows more distinct from the thorax than in those previously examined, and, further, the antennal sense organs and furcal hairs described by Börner[3] are both present.

The fact that the material first examined seemed so conclusive only serves to emphasise how exceedingly important it is, in dealing with this order of insects, to examine and describe in the minutest detail the integumentary structures. Conclusions drawn from the gross morphology generally give one erroneous ideas as to the affinities of species and genera, whilst the minuteness and accuracy with which one investigates must ever be the key to a better understanding of these interesting insects.

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[1] Journ. Economic Biology, 1909, vol. iv, pp. 45-50, pl. vi.

[2] Ann. Soc. Ent. Belg., 1900, vol. 44, pp. 7-10, pl.

[3] Wytsman's Gen. Insectorum, 1906, pp. 1-5, pl. See also Apterygoten-Fauna von Bremen, 1901, p. 82, figs. 34 and 35.

[JOURN. ECON. BIOL., December, 1909, vol. iv, No. 4.]

REVIEWS.

Austen, E. E.—Illustrations of African Blood-Sucking Flies, other than Mosquitoes and Tsetse-Flies. Pp. xv + 231, 13 plts. and 3 figs. London : 1909. Published by the Trustees of the British Museum. Price £1 7s. 6d.

This work deals with Blood-Sucking Flies of Africa, south of the Sahara, though Egypt is also included. The plates provide coloured illustrations of one hundred and two species, and the endeavour that those represented shall be readily recognisable from the figures, without the necessity of consulting detailed descriptions, has been fully realised. The notes on life-history, habits, and distribution are based on the latest available information, while the all-important subject of the dissemination of disease has been kept prominently in view, the statements of the investigators and observers being summarised under special headings. A noteworthy feature of the book is a chapter devoted to " Lists of African Blood-Sucking Flies at present known, arranged under Countries," enabling those interested in a particular Colony or Protectorate to see at a glance what species are known to occur there, and such will undoubtedly prove of great value.

The work is an important addition to the Natural History Museum publications, and a most valuable contribution to our knowledge of the Diptera of the African continent, and will be welcomed by economic entomologists and dipterologists generally throughout the world as a standard monograph upon the species it treats of.

W. E. C.

Blanchard, R.—L'Insecte et L'Infection, histoire naturelle et médicale des Arthropodes pathogènes. Fasc. Pp. 160, 197 text figs. Paris : Librairie Scientifique et Littéraire, 1909. Price 6 fr.

The first part of Professor Blanchard's work deals with the class Acariens, in which are included the Mites and Ticks. Chapter i is devoted to a general account of the morphology and anatomy of the *Ixodidae,* which is followed by one on the evolution and biology, the remaining portion of the work being devoted to descriptions of the different genera and species.

The majority of figures are poorly reproduced and badly printed.

W. E. C.

Boyce, Rubert W.—Mosquito or Man? The Conquest of the Tropical World. Pp. xvi + 267, 44 figs. London: John Murray, 1909. Price 10/6 net.

If for no other reason than that of educating the public mind to the vast importance of the Tropical Medical movement, this book will be welcomed by many. But it has an equally important value for the lucid yet concise history it gives of the important scientific discoveries that have been the outcome of this movement.

It is a great achievement to be able to write, as the author does. "The campaigns show that the three great insect-carried scourges of the tropics—the greatest enemies that mankind has ever had to contend with, namely, Malarial, Yellow Fever, and Sleeping Sickness—are now fully in hand and giving way, and with their conquest disappears the awful and grinding depression which seems to have gripped our forefathers. Now the situation is full of hope. The mosquito is no longer a nightmare; it can be got rid of. The tropical world is unfolding once again to the pioneers of commerce."

Professor Boyce commences by detailing the foundation of the Tropical Medicine movement in England, and pays a high tribute to the practical and far-seeing Minister, the Right Hon. Joseph Chamberlain. The growth of general and applied sanitation in the tropics is next dealt with, and the old doctrine of the miasmatic origin of disease. The forerunners of the discoveries of the mosquito origin of disease, such as Dr. Nott, Dr. Beauperthny, Daniel Blair, and Sir Patrick Manson, each are given their share of the honour to which they are so justly entitled.

Manson's discovery of *Filaria,* and the researches of Laveran and Ross form most fascinating chapters, followed by equally interesting ones on the plan of campaign against the mosquito, and the various insect-borne diseases.

To quote the author's own words: "the narrative would appear more like a fairy tale were it not based upon easily accessible reports and figures."

It is a book that cannot fail to command a wide sale, appealing as it does to all who are interested in scientific discovery, and also on account of the eminently practical bearing of such, and their immense importance to humanity.

A fuller index would have been a great acquisition.

W. E. C.

French, C.—A Handbook of the Destructive Insects of Victoria, with Notes on the Methods of Prevention and Extirpation. Part IV. Pp. 195, plts. lxv—xcviii. Melbourne: Osboldstone and Co., 1909. Price 2s. 6d.

The earlier parts of Mr. French's Handbook have been known to economic biologists for some years as concise and beautifully illustrated treatises upon the injurious insects and insect-eating birds of Victoria.

We welcome part iv, in which the high standard set at the commencement is fully maintained. The work opens with a copy of the "Amended Vegetation Diseases Act," and a List of the insects proclaimed under that Act, by Mr. E. Meeking. Then follow accounts of Fruit Flies, various insects injurious to fruit and forest trees, the Horse Bot Fly, and fourteen species of insect-eating birds. An Appendix detailing certain "materials in use for the destruction of noxious insects," brings to a conclusion the fourth part of a very interesting and practical work, which must prove very valuable to Victorian farmers, fruit growers, and agriculturists generally.

W. E. C.

Lefroy, H. M., and F. M. Howlett.—Indian Insect Life. A Manual of the Insects of the Plains. Pp. xii + 786, 84 plts. and 536 text figs. Calcutta: Thacker, Spink and Co., 1909. Price 30s.

The planning, superintending and writing of a work like the one before us is a task that the casual reader scarcely realises, and when this work has been crowded into the leisure of a busy life, we feel that every credit is due to Mr. Maxwell-Lefroy and his staff for what must be the foundation of economic entomology in India.

There are many points with which we disagree, *e.g.*, classification, the absence of references, the quotation of authors, etc., etc., but as these are so insignificant when compared with those with which we are in hearty accord, and for which we have only the warmest praise, we prefer to direct attention to some of the latter.

Mr. Lefroy is responsible for the greater portion of the work, whilst Mr. Howlett has written the sections dealing with Mallophaga, Diptera, *Cimicidae* and Anoplura, and Mr. I. H. Burkill a short and interesting interlude on Insects and Flowers.

The author opens with a comprehensive Introduction, in which he discusses the zoological position of insects, instinct and habit, classification, entomology in India, zoo-geographical divisions, food and habitat, and the relationship of insects to man.

Apart from the valuable descriptions, life-histories, and strictly economic information, all of which are given in great detail, accompanied by a wonderful wealth of illustrations, a series of most interesting sections are interspersed dealing with such subjects as, Where Insects Live, Cosmopolitan Insects, Deceptive Colouring, Attraction to Light, Gregariousness, Aquatic Insects, Relative Duration of Life, Myrmecophilous Insects, Insects as Food, Migration, How Insects protect themselves, Blood-sucking Insects, Song in Insects, etc.

All sections have received very thorough attention, indeed, we know of no other work on the Class Insecta that contains such a wealth of information, very much of which is original, whilst much has not been easily accessible heretofore.

A few words must be said in praise of the figures and plates. We know of no work on insects in which the half-tone and line blocks approach the high standard seen here. Of the plates the figures and colouring are all excellent, but it is a great pity that the tinted background was not omitted as on plates ii-vi. In only one instance has this added to the clearness of the figures, whilst in many cases, *e.g.*, plts. x, xvii, xix, xxi, and others, it has seriously detracted from their value.

Mr. Lefroy has made a notable addition to entomological literature, and one upon the completion of which he may feel justly proud.

W. E. C.

Troup, R. S.—Indian Woods and their Uses. Pp. 3 + ii + 273 + ccxviii. Indian Forest Memoirs. Vol. i, No. 1. Calcutta, 1909. Price 4s.

The frequency with which enquiries are made regarding the suitability of Indian woods for specific purposes, and the difficulty often experienced in obtaining such information, have induced the author to put together in convenient form a mass of data, the collection of which has occupied many years. No less than 554 species are dealt with.

The work is divided into two parts, the first of which treats of the various uses of Indian woods; in the second is given a descriptive list of the chief Indian woods. Here the scientific name of each species is given, the natural order, synonym, English and vernacular names, habitat, a brief description of the tree and wood, the weight per cubic foot, strength, and chief uses.

The indices occupy nearly half the work; first, there is a general subject index, then one to English and trade names, and finally a most comprehensive one to vernacular names.

The whole work forms a valuable epitome on the economy of Indian timbers, and cannot fail to be of service to all interested in such.

CURRENT LITERATURE.

I.—General Subject.

Banks, Nathan.—Directions for Collecting and Preserving Insects. U.S. Nat. Mus., Bull. 67, 1909, pp. xiii + 135, 1 plt. and 188 figs.

A very useful publication.

Felt, E. P.—Insects and Legislation. Journ. Econ. Entom., 1909, vol. ii, pp. 342-345.

Gossard, H. A.—Relation of Insects to Human Welfare. Journ. Econ. Entom., 1909, vol. ii, pp. 313-324.

Sanderson, E. D.—Publications of the Station Entomologist. Journ. Econ. Entom., 1909, vol. ii, pp. 268-277.

II.—Anatomy, Physiology, and Development.

Hegner, R. W.—Origin and early History of the Germ-Cells in some Chrysomelid Beetles. Journ. Morph., 1909, vol. xx, pp. 231-295, 4 plts.

Oudemans, A. C.—Über den systematischen Wert der weiblichen Genitalorgane bei den Suctoria. Zool. Anz., 1909, Bd. xxxiv, pp. 730-736, 11 figs.

Solowiow, P.—Zum Bau des Verschlussapparates des Stigmen bei den Insekten. Zool. Anz., 1909, Bd. xxxiv, pp. 705-711.

III.—General and Systematic Biology, and Geographical Distribution.

Blaisdell, F. E.—A Monographic Revision of the Coleoptera belonging to the Tenebrionide Tribe Eleodiini inhabiting the United States, Lower California, and adjacent Islands. U.S. Nat. Mus., Bull. 63, 1909, pp. xi + 524, 13 plts.

Cameron, P.—On some Undescribed *Ichneumonidae and Braconidae,* reared by Mr. T. Bambrigge Fletcher, R.N., from Ceylonese Lepidoptera (*Pterophidae*). Spolia Zeylanica, 1909, vol. vi, pp. 40-43.

Cockerell, T. D. A.—A new Coccid of the genus *Eriococcus*. Proc. Ent. Soc. Wash., 1909, pp. 167, 168.

Cockerell, T. D. A.—A new Braconid of the genus *Elasmosoma*. Ibid., pp. 168, 169.

Cockerell, T. D. A., and Rohwer, S. A.—A new gall-making Coccid on *Atriplex*. Ibid., pp. 169, 170.

Davidson, W. M.—Notes on *Aphididae* collected in the vicinity of Stanford University. Journ. Econ. Entom., 1909, vol. ii, pp. 299-305.

Felt, E. P.—Additional rearings in *Cecidomyiidae*. Journ. Econ. Entom., 1909, vol. ii, pp. 268-293.

Many new species briefly diagnosed.

Fletcher, T. B.—The Plume-Moths of Ceylon. Spolia Zeylanica, 1909, vol. vi, pp. 1-39, plts. A-F and map.

Gestro, R.—Coleopterorum Catalogus. Pars. 1. *Rhysodidae*. Pp. 1-11. Berlin: W. Junk, 1909.

Gillette, C. P.—Plant Louse Notes, family *Aphididae*. Journ. Econ. Entom., 1909, vol. ii, pp. 351-357, 16 figs.

Howard, C. W.—A New Species of *Haemaphysalis* from East Africa. Ann. Transv. Mus., 1909, vol. i, pp. 219-223, 10 figs.

H. africana, n.sp. has been found on the bird known as Burchell's Coucal, *Centropus burchelli*. All the four forms—males, females, nymphs, and larvae—were found on the host at the same time.

Howard, C. W.—A Feeding Habit of some Lourenço Marques Butterflies. Ann. Transv. Mus., 1909, vol. i, pp. 224, 225.

The author records a small butterfly, *Crenis boisduvali* (Wallengren), puncturing, by means of its proboscis, the fruit of the apple and quince. Two other species are mentioned as attacking oranges and naartjes, whilst three species of moths common in the Transvaal have a similar habit of puncturing fruit, all of which cases serve to throw discredit upon the old theory that the Lepidoptera are, as a rule, destructive only in the larval stage.

Howard, C. W.—A Note on the Copulation of Ticks. Ann. Transv. Mus., 1909, vol. i, p. 225.

Jackson, A. D.—A Study of Ohio Forms of the Genus *Lepidocyrtus*. Ohio Nat., 1909, vol. ix, pp. 525-538, 22 figs.

The author gives some interesting notes on the genus generally and describes two new species, *L. sanguineus* and *L. luteus*.

Marchal, P.—Contribution à l'étude des Coccides de l'Afrique occidentale. Mem. Soc. Zool. France, 1909, T. xxii, pp. 165-182, plts. 9, 10, and 8 figs.

Needham, J. G.—Studies of Aquatic Insects. N.Y. State Mus., Mus. Bull. 134, Albany, 1909, pp. 71-75, 1 plt. and 1 fig.

Osgood, W. H.—Revision of the Mice of the American Genus *Peromyscus*. U.S. Dept. Agric., Bur. of Biol. Sur., No. 28, 1909, pp. v + 285, 8 plts.

Patton, W. S.—The Life-Cycle of a species of *Crithidia* parasitic in the intestinal tracts of *Tabanus hilarius* and *Tabanus* sp.? Archiv. für Protistenkunde, 1909, Bd. xv, pp. 333-362, plt. 30, and 2 figs.

Quaintance, A. L.—A new Genus of *Aleyrodidae*, with remarks on *A. nubifera*, Berger, and *A. citri*, Riley and Howard. U.S. Dept. Agric., Bur. of Entom., Tech. Ser. No. 12, pt. ix, 1909, pp. 169-174, 2 figs.

This is the *Aleyrodes perseae* described by this author in 1900. It is now removed to a new genus named *Paraleyrodes*.

Severin, H. C. and H. H. P.—A Preliminary List of the Coccidae of Wisconsin. Journ. Econ. Entom., 1909, vol. ii, pp. 296-298.

Swaine, J. M.—Catalogue of the described *Scolytidae* of America, North of Mexico. N.Y. State Mus., Mus. Bull. 134, Albany, 1909, pp. 76-159, plts. 3-17.

Swierstra, C. J.—Check List of the Lepidoptera-Rhopalocera of the Transvaal, with Notes on some of the Species. Ann. Transv. Mus., 1909, vol. i, pp. 235-299.

Wilson, H. F.—Some New Records of *Aphididae* in North America. Journ. Econ. Entom., 1909, vol. ii, pp. 346-350, 2 figs.

Records the finding of *Pentalonia nigronervosa*, Coq., on bananas, *Aphis angelicae*, Koch, on angelica and ivy, and *Drepanosiphum platanoides* on maple.

IV.—Agriculture and Horticulture.

Ballou, H. A.—The Scarabee of the Sweet Potato. W.I. Bull., 1909, vol. x, pp. 180-196, 10 figs.

Carpenter, G. H.—Injurious Insects and other Animals observed in Ireland during the year 1908. Econ. Proc. Roy. Dublin Soc., 1909, vol. i, pp. 589-611, plts. lv-lix, and 8 figs.

Amongst the many interesting animals dealt with in this report mention must be made of the accounts of *Dascillus cervinus* (Linn.), the Silky Beetle, the larvae of which have been thought to be injurious to young oat-plants and grasses, and a new bulb mite *Histiogaster corticalis* (Michael).

Cherry, T.—The Victorian Potato Industry. The Inter-State Conference and the Irish Blight. Journ. Vict. Dept. Agric., 1909, vol. vii, pp. 593-602, 8 figs.

Chittenden, F. H.—Miscellaneous Notes on Truck-crop Insects. U.S. Dept. Agric., Bur. of Entom., Bull. No. 66, pt. vii, 1909, pp. 93-97.

Felt, E. P.—24th Report of the State Entomologist, 1908. N.Y. State Mus., Mus. Bull. 134, Albany, 1909, pp. 5-70, 1 plt. and 21 figs.

Fernald, H. T.—A Parasite of the Asparagus Beetle. Journ. Econ. Entom., 1909, vol. ii, pp. 278, 279.

Fernald, H. T.—A New Treatment for Wireworms. Journ. Econ. Entom., 1909, vol. ii, pp. 279, 280.

Foster, S. W.—Additional Observations on the Lesser Apple Worm. U.S. Dept. Agric., Bur. of Entom., Bull. No. 80, pt. iii, 1909, pp. 45-50, plt. iii.

Freeman, E. M., and E. C. Johnson.—The Loose Smuts of Barley and Wheat. U.S. Dept. Agric., Bur. Plant Indus., Bull. No. 152, 1909, pp. 1-48, plts. i-vi.

Froggatt, W. W.—Report on Parasitic and Injurious Insects. N.S.W. Dept. Agric., Sydney, 1909, pp. v + 115, 22 plts.

This interesting report consists of three parts, the first is a general report upon the commercial value of introduced parasites to deal with insects that are pests, and also treats of the range and spread of Fruit-flies and the methods adopted in other countries to check them, and the value of parasites in exterminating them. It is somewhat gossipy, and loosely written.

Part II. consists of notes on parasites or insects that have been introduced from foreign countries to check or exterminate injurious insects, whilst Part III., by far the most important one, gives an account of the *Trypetidae*, treating of their habits, range, and suggestions for destroying them.

The following are described as new: *Dacus frenchi* and *D. ornatissimus,* from New Caledonia; *D. curvipennis,* from Fiji; and *Ceratitis striata,* from Ceylon.

Goodwin, W. H.—The Raspberry Byturus. *Byturus unicolor.* Ohio Agric. Exp. Stat., Bull. No. 202, 1909, pp. 173-186, 8 figs.

Gunn, D.—Silkworm Culture in the Transvaal. Transv. Agric. Journ., 1909, vol. vii, pp. 662-673, 9 figs.

Halsted, B. D.—Report of the Botanist. 29th Ann. Rpt. New Jersey Agric. Exp. Stat., 1909, pp. 181-301, 33 plts.

Herrick, G. W.—Notes on Mites affecting Chickens. Journ. Econ. Entom., 1909, vol. ii, pp. 341, 342.

Johnston, J. R.—The Bud-Rot of the Cocoanut Palm. U.S. Dept. Agric., Bur. Plant Indus., Circ. No. 36, 1909, pp. 1-5.

Kirk, T. W.—Report of the Biologist. 16th Ann. Rpt. N.Z. Dept. Agric., 1908, pp. 97-162, 24 plts., and 9 text figs.

This Report chronicles under various headings the excellent work that is being carried out by the Chief of the Division of Biology and Horticulture.

The chief points to which we would draw attention are the accounts of Diseases of garden plants, Diseases of fruit trees, and Diseases of potatoes. There is also a well-illustrated account of the "Gum-tree Blight" due to *Eriococcus coriaceus,* Maskell, and one on Eelworms.

Kirk, T. W.—Diseases of Turnips. N.Z. Dept. Agric., Div. of Biol., Bull. No. 14, 1909, pp. 1-4, 5 figs.

Kirk, T. W.—Fruit Flies. Ibid., Bull. No. 22, 1909, pp. 1-18, 8 figs.

Kirk, T. W., and A. H. Cockayne.—The Gum-tree Scale. N.Z. Dept. Agric. Div. of Biol., Bull. No. 13, 1909, pp. 1-8, 7 plts, 4 figs.

Kirk, T. W., and A. H. Cockayne.—Eelworms. Ibid., Bull. No. 20, 1909, pp. 1-7, 9 figs.

Kirk, T. W., and A. H. Cockayne.—Parasitic Plants. Ibid., Bull. No. 21, 1909, pp. 1-4, 4 figs.

Kirk, T. W., and A. H. Cockayne.—Bacterial Diseases of Plants. Ibid., Bull. No. 23, 1909, pp. 1-8, 1 plt.

Lefroy, H. Maxwell.—The Cultivation of Shellac as an Agricultural product. Agric. Journ. Ind., 1909, vol. iv, pp. 258-270, plts. xxiv-xxx.

Lefroy, H. M.—Thrips in Tea. Ibid., pp. 282-290, plt. xxxi.

Lipman, J. G.—Azotobacter Studies. 29th Ann. Rpt. New Jersey Agric. Exp. Stat., 1909, pp. 135-147.

Longman, Sibyl.—The Dry Rot of Potatoes. Journ. Linn. Soc. (Botany), 1909, vol. xxxix, pp. 120-129, plt. 10.

Lounsbury, Chas. P.—Report of the Government Entomologist for the Year 1908. Rpt. Dept. Agr. C. of G.H., 1909, pp. 55-70.

Lounsbury, Chas. P.—Third Annual Report of the Committee of Control of the South African Central Locust Bureau. Pp. iv + 68, Cape Town, 1909.

A record of valuable work of vast import to South Africa.

Lounsbury, Chas. P.—Dry Rot of the Potato. Agric. Journ. C. of G.H., 1909, vol. xxxv, pp. 42-48, 3 figs.

This disease, due to *Nectria solani,* has been brought into prominence in South Africa owing to the Transvaal authorities rejecting any consignment in which one per cent. of the tubers is infected.

The author gives various preventive methods, but nothing is said as to eradicating the disease or destroying the spores.

Lounsbury, Chas. P.—Prune Rust. A leaf disease of Prune, Peach, and Apricot trees. Agric. Journ. C. of G.H., 1909, vol. xxxv, pp. 98-103, 3 figs.

MacDougall, R. S.—The Genus *Chermes* in its Relation to Forestry. Journ. Bd. Agric., 1909, vol. xvi, pp. 441-453, 2 plts. and 2 figs.

Morrill, A. W., and W. W. Yothers.—Preparations for Winter Fumigation for the Citrus White Fly. U.S. Dept. Agric., Bur. of Entom., Circ. No. 111, 1909, pp. 1-12, 4 figs.

Moulton, Dudley.—The Pear Thrips. U.S. Dept. Agric., Bur. of Entom., Bull. No. 68, pt. i, revised, 1909, pp. 1-16, plts. i, ii, and 8 text figs.

Moulton, Dudley.—The Pear Thrips and its control. U.S. Dept. Agric., Bur. of Entom., Bull. No. 80, pt. iv, 1909, pp. 51-66, plts. iv-vi, 5 figs.

Newell, W., and A. H. Rosenfeld. Some Common Insects injurious to Truck Crops. State Crop Pest Comms. Louisiana, Circ. No. 27, 1909, pp. 93-131, 21 figs.

Newell, W.—The Fumigation of Nursery Stock with Hydrocyanic Acid Gas. State Crop Pest Comms. Louisiana, Circ. No. 29, 1909, pp. 139-150, 5 figs.

Newell, Wilmon.—Measures suggested against the Argentine Ant as a Household Pest. Journ. Econ. Entom., 1909, vol. ii, pp. 324-332, plt. 8, 1 fig.

Phillips, J. L.—Fumigation, Dosage and Time of Exposure. Journ. Econ. Entom., 1909, vol. ii, pp. 280-283.

Popenhoe, C. H.—The Colorado Potato Beetle in Virginia in 1908. U.S. Dept. Agric., Bur. of Entom., Bull. No. 82, pt. 1, 1909, pp. 1-8, plts. 1 and 2.

Poppins, B.—Remarks on an injurious Capsid in the Cocoa Plantations of West Africa. Entom. Mon. Mag., 1909, p. 162.

Reh, L.—Die Schildlaus-Krankheit der Kokospalmen. Tropenpflanzer, 1909, No. 10, pp. 1-6.

Robertson, W.—Report of the Director, Veterinary Laboratory, Grahamstown for the Year 1908. Rpt. Dept. Agr. C. of G.H., 1909, pp. 35-39.

Russell, H. M.—The Greenhouse Thrips. U.S. Dept. Agric., Bur. of Entom., Bull. No. 64, pt. vi, 1909, pp. 43-60, 3 figs.

Gives an account of the life-history of *Heliothrips haemorrhoidalis*, Bouché.

Sargeant, F. P.—Agricultural and Horticultural Preparations. Pp. 46. London: The Pharmaceutical Press, 1909.

Schultz, H. F.—*Brassolis isthmia,* a Lepidopterous Insect highly injurious to Cocoanut Culture in the Panama Canal Zone. Proc. Entom. Soc. Wash., 1909, vol. x, p. 164.

Scott, W. M.—Lime-sulphur mixtures for the Summer Spraying of Orchards. U.S. Dept. Agric., Bur. of Plant Ind., Circ. No. 27, 1909, pp. 1-17.

Selby, A. D., and T. F. Manns.—Studies in Diseases of Cereals and Grasses. Ohio Agric. Exp. Stat., Bull. No. 203, 1909, pp. 187-236, plts. i-xiv, and 7 figs.

Treats of a new Anthracnose disease of certain cereals and grasses due to *Colletotrichum cereale,* n.sp., and the fungus of wheat scab, *Fusarium roseum,* Lk.

Smith, John B.—Report of the Entomologist. 29th Ann. Rpt. New Jersey Agric. Exp. Stat., 1909, pp. 305-378, 9 figs.

Smith, John B.—Report on the Mosquito Work for 1908. 29th Ann. Rpt. New Jersey Agric. Exp. Stat., 1909, pp. 381-415.

Swenk, Myron H.—*Elodes* as an enemy of planted Grain. Journ. Econ. Entom., 1909, vol. ii, pp. 332-336, plts. 9, 10.

Thornton, R. W.—Relative Rust-resistance and yield of various varieties of Wheat, Oats, and Barley. Agric. Journ. C. of G.H., 1909, vol. xxxv, pp. 65-73.

Thornton, R. W.—Relative Rust-resistance and yield of various varieties of Wheat and Oats. Ibid, pp. 74-76.

Tucker, E. S.—New Breeding Records of the Coffee-bean Weevil (*Araecerus fasciculatus,* De Geer). U.S. Dept. Agric., Bur. of Entom., Bull. No. 64, pt. viii, 1909, pp. 61-64, plt. iii, and 1 fig.

V.—Forestry.

Duchesne, M. C.—Practical English Estate Forestry. Trans. Surv. Inst., 1909, vol. xli, pp. 263-308.

Duchesne, M. C.—The Beech Coccus (*Cryptococcus fagi*). Q. Journ. Fores., 1909, vol. iii, pp. 345-350.

VI.—Fisheries.

Carr, A. M.—The Food and Condition of Fish obtained from the North-East Coast. Rpt. Northumberland Sea Fish. Comm. 1908-09, 1909, pp. 41-50.

Meek, A.—Migrations of Inshore Flat Fish. Rpt. Northumberland Sea Fish. Comm. 1908-09, 1909, pp. 30, 31.

Meek, A.—Migrations of Lobsters. Ibid., pp. 32-35.

Meek, A.—A Proposed Close Season for Crabs. Ibid., pp. 36-38, chart.

Nelson, J.—Studies of Natural Oyster Propagation at Barnegat, 1908. 29th Ann. Rpt. New Jersey Agric. Exp. Stat., 1909, pp. 151-177, plts. i-vi.

VII.—Medicine.

Atkinson, J. M.—A Possible Natural Enemy to the Mosquito. Lancet, 1909 (Sept. 4th), pp. 708-710, 3 figs.

Records *Lispa sinensis*, Schiner, feeding upon the larvae.

Bashford, E. F.—Cancer in Man and Animals. Lancet, 1909 (Sept. 4th), pp. 691-701.

Daniels, C. W.—The Persistence of the Tropical Diseases of Man due to Protozoa. Lancet, 1909 (Aug. 14th), pp. 460, 461.

Herms, W. B.—Medical Entomology, its scope and methods. Journ. Econ. Entom., 1909, vol. ii, pp. 265-268.

Kinghorn, A. & R. E. Montgomery.—On the Flagellates occurring in the intestine of *Glossina palpalis* and in the intestine and proboscis of *Glossina morsitans*. Ann. Trop. Med. and Paras., 1909, vol. iii, pp. 259-276.

Kinghorn, A. & R. E. Montgomery.—Second Report on Human Trypanosomiasis in North-Eastern Rhodesia and Nyasaland. Ibid., pp. 277-309.

Patterson, R. Lloyd.—An Indian Screw Worm. Indian Med. Gaz., 1909, vol. xliv, pp. 374-376, 1 plt.

VIII.—Animal Diseases, etc.

Borthwick, J. D.—Report of the Chief Veterinary Surgeon for the Year 1908. Rpt. Dept. Agr. C. of G.H., 1909, pp. 21-33.

Carpenter, Geo. H., and W. F. Prendergast.—The Warble Flies. Further Experiments as to Life-history and Treatment. Journ. Dept. Agric. and Tech. Instr., Ireland, 1909, vol. ix, pp. 2-13, 1 plt. and 2 figs.

Cleland, J. B.—Streptococcal Granuloma of Lung of a Camel. Journ. Trop. Vet. Sci., 1909, vol. iv, page 133.

Dixon, R. W.—Catarrhal Fever of Sheep-Bluetongue. Agric. Journ. C. of G.H., 1909, vol. xxxiv, pp. 487-491.

Elsey, Stanley.—The Ostrich Industry. The possibility of improving the standard of veld-grown feathers. Agric. Journ. C. of G.H., 1909, vol. xxxv, pp. 312-315.

Evans, G. H., and T. Rennie.—Notes on some Parasites in Burma.—II. Journ. Trop. Vet. Sci., 1909, vol. iv, pp. 134-143, plts. v-viii, and 3 figs.

Gilruth, J. A.—Report of the Chief Veterinarian. 16th Ann. Rpt. N.Z. Dept. Agric. 1908, pp. 163-214, 3 plts.

Amongst the many diseases and parasites mentioned, the following are dealt with at some length: Tuberculosis; Septic Metritis in Cows; Contagious Stomatitis in Lambs and Sheep; Facial Eczema in Sheep; Partial Hernia in Fat Lambs; *Haematopinus* of Sheep; the Sheep Maggot; New growths simulating Tuberculosis lesions due to Cysticerci in Sheep; and Bovine contagious Mammitis.

Hooker, W. A.—Some Host Relations of Ticks. Journ. Econ. Entom, 1909, vol. 2, pp. 251-257.

Lantz, D. E.—The Brown Rat in the United States. U.S. Dept. Agric., Biol. Surv., Bull No. 33, 1909, pp. 1-54, plts. i-iii, 4 figs.

A very valuable and practical paper.

Leese, A. S.—Experiments regarding the Natural Transmission of Surra carried out at Mohand in 1908. Journ. Trop. Vet. Sci., 1909, vol. iv, pp. 107-132.

MacDougall, R. S.—Sheep Maggot and Related Flies, their Classification, life-history, and habits. Trans. High. and Agr. Soc. Scot., 1909, pp. 135-174, figs. 17-25.

Montgomery, R. E., and A. Kinghorn.—A Further Report on Trypanosomiasis of Domestic Stock in Northern Rhodesia (North-Eastern Rhodesia). Ann. Trop. Med. and Paras., 1909, vol. iii, pp. 311-374, plts. iii, iv, 1 map.

Piper, S. E.—The Nevada Mouse Plague of 1907-8. U.S. Dept. Agric., Farmers' Bull. 352, 1909, pp. 1-23, 9 figs.

The seriousness of the recent mouse plague in Humboldt Valley, Nevada, may be gathered from the bulletin before us, in which the author points out that at the height of abundance from 8,000 to 12,000 mice were present per acre. Serious losses in hay and root crops was the result, in addition to the death of willows, poplars, etc., in the affected area. The total loss is estimated at about £60,000.

The means taken to eradicate these pests (*Microtus montanus*) were by poisoning with strychnine, irrigation, winter flooding, burning, the use of trained dogs, and the destruction of winter cover.

Shipley, A. E.—The Ectoparasites of the Red Grouse (*Lagopus scoticus*). Proc. Zool. Soc. Lond., 1909, pp. 309-334, plts. xxxv-xlvii.

Shipley, A. E.—The Thread-Worms (Nematoda) of the Red Grouse *(Lagopus scoticus).* Proc. Zool. Soc. Lond., 1909, pp. 335-350, plts. xlviii-lv.

Shipley, A. E.—The Tape-Worms (Cestoda) of the Red Grouse *(Lagopus scoticus).* Proc. Zool. Soc. Lond., 1909, pp. 351-363, plts. lvi-lx.

Shipley, A. E.—Internal Parasites of Birds Allied to the Grouse. Proc. Zool. Soc. Lond., 1909, pp. 363-368.

Whatever facts may be gleaned from the Grouse Disease Inquiry bearing directly on the cause and nature of the disease, a wealth of material has been obtained in the form of ecto- and endoparasites and these have fortunately been described by Dr. Shipley.

The four beautifully illustrated memoirs before us contain descriptions of the external features and internal structure of many most interesting parasites. Thus the *Goniodes tetraonis*, Denny, is described at great length and very beautifully illustrated. Two carefully executed figures illustrate the description of the Grouse-fly, *Ornithomyia lagopodis*, Sharp. The structure of *Trichostrongylus pergracilis* (Cobbold) is described in detail and an interesting account given of the life-history.

Incidently Dr. Shipley raises a large number of most interesting problems to the economic biologist, evidencing how very thoroughly the work has been done, not the least interesting of these is the general discussion on the relation of ectoparasites to the endoparasites of the grouse.

Theiler, A.—Diseases, Ticks, and their eradication. Trans. Agric. Journ., 1909, vol. vii, pp. 685-699.

Watkins-Pitchford, H.—Dipping and Tick-Destroying Agents. Natal Agric. Journ., 1909, vol. xii, pp. 436-459, 2 plts., and 2 text figs.

ERRATUM.

In the figure on p. 63 illustrating Dr. Shipley's paper "On the Relation of Certain Cestode and Nematode Parasites to Bacterial Disease," for "7 specimens of *Trichostrongylus pergracilis* (Cobbold)" read "7 specimens of *Cystidicola farionis*, Fischer."

PROCEEDINGS

OF THE

ASSOCIATION OF ECONOMIC BIOLOGISTS.

ANNUAL MEETING, July 13-15, 1909.

TUESDAY, JULY 13TH, 1909.

The Annual Meeting was held in the School of Forestry, Oxford.

The President, Dr. A. E. Shipley, F.R.S., occupied the chair, and there was a large attendance.

The minutes of the previous meeting were read, confirmed, and signed.

Mr. Collinge read the following Annual Report:—

FOURTH ANNUAL REPORT.

In presenting their Fourth Annual Report (covering the period from January, 1908, to July, 1909), your Council are pleased to report a continued steady growth in the numerical strength of the Association.

The total number of members of all classes on June 30th, 1909, was 132, namely:—

Honorary Members	8
Ordinary	107
Associate	17
	132

There are also eight candidates awaiting election.

A successful meeting was held at University College, London, on April 15th, 1908, and a two-days' meeting at Edinburgh, on July 28th and 29th.

A fourth part of the "Proceedings" of the Association has been issued, bringing to a conclusion volume 1.

Your Council have decided to cease this publication as at present published, and arrangements have been made whereby all future members, and all members contributing £1 1s. 0d. per year to the Association funds, will receive free the "Journal of Economic Biology," including the "Proceedings." Other members subscribing 10s. 6d. will receive the "Proceedings" only.

The total receipts up to June 30th, 1909, amounted to £31 16s. 9d., whilst the total expenditure for the same period amounted to £10 0s. 0d., leaving a balance in the hands of the Honorary Treasurer of £86 19s. 1d.

There is also a balance of £50 1s. 0d. for outstanding subscriptions.

Your Council have received and accepted an invitation to meet at the University of Manchester in July, 1910.

In accordance with Law 12, the Council nominated the following as the Officers of the Association for the year 1909-1910. No further nominations having been received these were put to the meeting and declared elected.

President:

A. E. Shipley, M.A., Hon.D.Sc., F.R.S.

Vice-Presidents:

Sir Patrick Manson, K.C.M.G., LL.D., M.D., F.R.S.
Professor E. B. Poulton, M.A., D.Sc., F.R.S.
Fred. V. Theobald, M.A.

Council:

Colonel A. W. Alcock, M.B., LL.D., F.R.S.
W. G. Freeman, B.Sc., A.R.C.S., F.L.S.
R. Stewart MacDougall, M.A., D.Sc., F.R.S.E.
Francis H. A. Marshall, M.A., D.Sc., F.R.S.E.
Robert Newstead, M.Sc., A.L.S., F.E.S.
Professor Ronald Ross, C.B., F.R.C.S., F.R.S.
Fraser Story, F.R.S.E.
Cecil Warburton, M.A.

Hon. Treasurer:

Herbert Stone, F.L.S.

Hon. Secretaries:

Walter E. Collinge, M.Sc., F.L.S., F.E.S.
Vacant.

The President explained that Dr. Gordon Hewitt's name had been withdrawn as one of the Honorary Secretaries owing to his having been appointed Government Entomologist to Canada, an appointment upon which he had the hearty congratulations of the Association and the best wishes of its members.

The following alterations in the Laws were then read.

In accordance with Law 18, the Council propose the following alterations in the Laws:—

LAW 4. Members shall pay an Annual Subscription of £1 1s., due in advance, on the first January in each year, or a Composition Fee of £10 10s. All Ordinary Members on election shall pay an Entrance Fee of 10s. 6d.

Members subscribing £1 1s. per year receive free (from January, 1910) the "Journal of Economic Biology."

Those members elected prior to June, 1909, who subscribe 10s. 6d. will receive the "Proceedings" only.

LAW 12. "A General Secretary" *to read* "two Honorary Secretaries," and such other changes in the Laws as to bring them into conformity with this.

No amendments having been received the propositions were put to the meeting and declared carried.

The President, Dr. A. E. Shipley, F.R.S., read a paper on "The Relation of Certain Cestode and Nematode Parasites to Bacterial Disease."[1] He argued that the piercing of the wall of the alimentary canal by parasites carries with it bacterial infection. In the case of the "disease" of Grouse, the caecum is crowded with the thread-worms *Trichostrongylus pergracilis,* and the walls of the caecum become very thin. The anterior ends of the parasites pierce the walls of the alimentary canal, and this is followed by an intrusion of bacteria into the submucous layers. It is found that there is a definite relation between the number of worms in the alimentary canal and the number of bacteria in the body of the host. This perforation of the intestinal wall and subsequent invasion of the lesions by bacilli is of importance in such diseases as peritonitis and appendicitis. Such worms as *Oxyuris,* etc., are frequently associated with peritonitis and other entozoa with appendicitis. He strongly advocated the use of Vermifuges, which are used less than heretofore, and in this he was supported by Prof. Osler in the discussion which followed.

Mr. E. P. Jepson communicated the results of his experiments in the breeding of *Musca domestica* during the winter under

[1] Paper published *in extenso* in the Journal of Economic Biology, 1909, vol. iv, pp. 61-71.

definitely controlled conditions.[1] In February he reared house flies occurring in the warm college bakehouse on moist germinating bread, and the time of development, at an average temperature of about 70° F., was three weeks.

Mr. C. Warburton gave an account of his experiments on the life-histories of Human Pediculi. By feeding the developing and mature lice on the back of the hand two or three times per day he found that the female of *Pediculus vestimenti* laid 124 eggs in 25 days. The eggs began to hatch in 8 days and continued to do so for about a month. The larva moulted three times and became an imago in 11 days. He found that they feed immediately after hatching. Although great difficulty was experienced in breeding this species still greater trouble was encountered in breeding *P. cervicalis* (*P. capilis*). A single female deposited 48 eggs, which hatched in 17-18 days, the first moult took place a week later, and the later stages of the life history were all correspondingly lengthened compared with those of *P. vestimenti.*

Mr. Walter E. Collinge described the part played by the Collembola or "Springtails" in economic entomology.[2] These minute insects have not been regarded as being of economic importance until recently, and the author showed by a series of observations which he had made, and by adducing the evidence of other observers, that a considerable number of species are injurious to developing seeds, bulbs, orchids, and other plants.

Wednesday, July 14th, 1909.

Mr. A. D. Darbishire gave an account of the actual and possible application of recent discoveries in heredity to economic problems. Of the former the most important is the discovery by Prof. Biffen of a variety of wheat that is immune to the rust fungus. Mr. Darbishire described the general principles of Mendelism and the importance of the discovery of the segregation of dominant and recessive characters : especially the breeding time of the recessives. This is important inasmuch as the crossing of an organism having a resistant character with one having a susceptible character the offspring will be resistant according as this character is dominant or recessive, the latter character being isolated more speedily. He dealt with the importance of such a case where the two "characters" are—the presence of a character in the one and the absence of that character

[1] Paper published *in extenso* in the Journal of Economic Biology, 1909, vol. iv, pp. 78-82.

[2] Paper published *in extenso* in the Journal of Economic Biology, 1909, vol. iv, pp. 83-86.

in the other case. One may be able to increase the saccharine contents of such a vegetable as the pea by the application of this discovery, *i.e.*, by the selection of the absorptive character which is different in round and wrinkled peas.

A number of observations which the author had made tend to show that to some extent the character of "the resistance to the attacks of the beetle *Bruchus*" may possibly be dealt with according to Mendelian principles. A number of examples of the results of breeding experiments with peas were shown.

Mr. S. A. Neave communicated some notes on "The distribution and habits of *Glossina palpalis*."[1] The author had made these observations in the Congo Free State in 1907 and in North East Rhodesia in 1908. It would appear that the high plateau country which forms the watershed between the basins of the Congo and Zambesi rivers forms a barrier against the southward extension of the distribution of the fly. In the Katanga region of the Congo Free State *G. palpalis* was everywhere accompanied by Butterflies and other insects, which zoologists associate with the faunal region of the tropical West Coast. He was of the opinion that on the whole this species of Tse-tse will not be found to occur in the Zambezi basin, an important fact in view of the possibility of the spread of Sleeping Sickness into South Africa entertained by some authorities.

Mr. Geoffrey Smith gave an account of some observations which he had made in co-operation with Prof. Dreyer on two bacteria that are always found upon the outside of the shore crab, *Carcinus malvas,* and which are always to be obtained from the blood of dying or recently dead crabs. Both bacteria when grown as pure cultures in fish produce a powerful toxin which kills healthy crabs almost instantaneously when injected into them. A toxin can be filtered from the cultures, which is destroyed by heating for half-an-hour at 50° C. If, however, the unfiltered culture be heated to 60° C. and upwards for more than an hour, its toxic properties are not destroyed. There appears to be therefore two substances, one of which does not get into the filtrate and which is not destroyed at higher temperatures. This substance may play a part in the dangerous qualities of stale crustacea as food. With regard to the resistance of the crab against these bacteria, strong injections of the cultures are at once fatal, but if the bacteria are washed and injected in very dilute quantities the crabs very frequently survive the injection. Showing that the bacteria have been destroyed by phagocytosis or by some other means. Similar bacteria have been isolated from the outside

[1] Paper published *in extenso* in the Journal of Economic Biology, 1909, vol. iv, pp. 109-113.

of the freshwater crayfish, but they do not exhibit such marked toxic characters as the foregoing. Hofer, of Munich, considers the crayfish plague to be due to a special bacillus which he has found in plague-stricken areas. Investigations are being conducted which are intended to discover the relation of this plague bacillus to other poisonous bacteria living on the outside of crabs, lobsters, and crayfish.

Prof. G. H. F. Nuttall and Dr. S. Hadwen gave an account of their discovery of a successful curative treatment of Piroplasmosis. The Piroplasma, which is communicated by ticks to dogs in the one case and cattle, where it causes "Red-water Fever," in the other occurs in red blood corpuscles. In several cases 80 to 85 per cent. of corpuscles are infected, and the escape of the parasites during their multiplication into the blood gives rise to the characteristic Haemoglobinurea. The life cycle, which was described, bears a definite relation to the treatment as the double pyriform and large rounded forms of the parasite are dominant in the blood. It was found that if Trypanblan was injected subcutaneously or intravenously all the pyriform parasites disappeared and the remainder of the parasites degenerated two hours later. The animals (dogs) showed no symptoms. After about 10 or 12 days the parasites appear again in very small numbers, but the animals appear to be quite well and the parasites disappear. One injection was sufficient, and practically all the dogs injected were cured, all the controls (uninjected) dying.

An 100 per cent. mortality, which occurs in this disease in dogs, was converted into an 80 per cent. recovery. This drug has the same effect on the Piroplasma of cattle; it is destroyed after about two hours, but further investigation is necessary in the case of this disease before the drug can be put to practical use. No curative drug has yet been found in the case of East Coast Fever, which is due to the so-called *Piroplasma parvum,* but it is not recognised as a *Piroplasma.*

Prof. E. B. Poulton exhibited a large series of Predaceous Insects, together with their prey. They were chiefly Diptera belonging to the families of *Asilidae* and *Empidae.*

Prof. W. Somerville also exhibited a large number of parasitic fungi.

Thursday, July 15th, 1909.

Dr. C. Gordon Hewitt gave a further account of his investigations of the large larch sawfly *Nematus erichsoni.* After briefly describing the previous work and nature of attack an account of the

natural enemies was given. It is found that the ichneumon parasite in the larvae of the sawfly is increasing in numbers. In 1908 nearly 6 per cent. of the cocoons collected from different plantations in the Lake District were parasitised; this year over 15 per cent. of cocoons from the same plantations were parasitised. An ichneumon *Microcryphis labralis,* which is probably a hyper-parasite has been discovered. About 10 per cent. of the cocoons were attacked during the past winter by a fungal parasite, a species of *Cordyceps,* the mode of infection which is believed to be terrestrial by the author. The field vole, *Microtus agrestis,* is destroying an increasing number of pupating larvae. The protection and winter feeding of useful insectivorous birds has been undertaken, and in 1908 33 per cent. of the nest boxes were occupied. In spite of these natural enemies and the success of eradicative measures in the younger plantations, the author expressed the opinion that the results of this attack, which was spreading, would be of a very grave character, and Professor Somerville, in the discussion, regarded the outlook with great misgivings in view of the fatal results of the attack in Canada in 1890-1895, when practically all the eastern larches were destroyed.

Mr. A. J. Grove gave an account of the anatomy of the rose aphid, *Siphonophora rosarum,* especial attention being given to the character and method of working of the greatly modified mouthparts.

A paper by Mr. Cecil H. Hooper on the blossoming and pollen of our hardy cultivated plants was communicated. The object of Mr. Hooper's investigations has been to obtain some information on the injury done to blossoms by frost and to ascertain the order of flowering of different varieties for the purpose of cross fertilisation in order to group those that flower at the same time. It is convenient for spraying to have varieties at the same stage of flowering near together. The paper was illustrated by numerous photographs.

On the afternoon of July 14th a very enjoyable excursion was made to Tubney and Bagley Woods, under the leadership of Prof. Somerville and Mr. Grosvenor.

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